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ABSTRACT

This curriculum guide is the last (Series VII) in a six-volume set that comprises the Sea Week Curriculum Series developed in Alaska. The guide lends itself to the sixth-grade curriculum but can be adapted to preschool, secondary, and adult education. Eight units contain 43 activities with worksheets that cover the following topics: (1) the values of rivers, wetlands, and the sea; (2) marine mammals; (3) logging, fisheries, and wildlife; (4) oil and oil development; (5) community planning along Alaska's coasts and rivers; (6) weather; (7) a review of Sea Week's past; and (8) a Sea Week camping experience. An introduction provides information designed to help teachers become familiar with the contents of the curriculum guide and to assist in planning. Each unit contains information on student objectives, and activity background, vocabulary, materials, and procedure. Activities engage students in interdisciplinary projects that involve the skills of classifying, identifying, comparing, computing, measuring, game playing, role playing, writing, observing, mapping, collecting data, recording data, and analyzing data. An annotated bibliography contains 200 resources. A packet of teacher reproducible worksheet masters accompanies the curriculum guide. (LZ)

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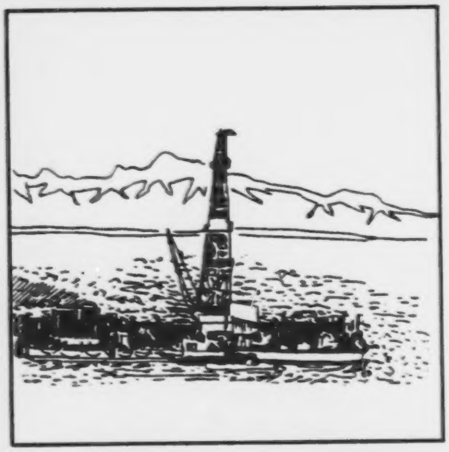
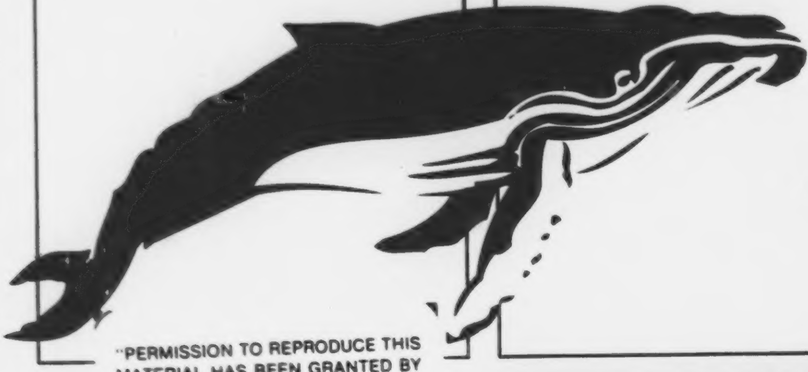


alaska sea week

Curriculum Series: VII



Marine Mammals, Coastal and River Issues

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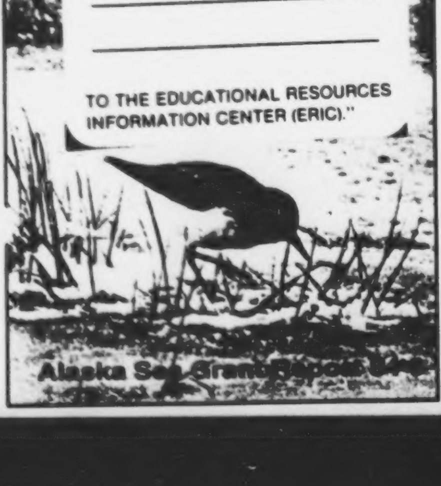

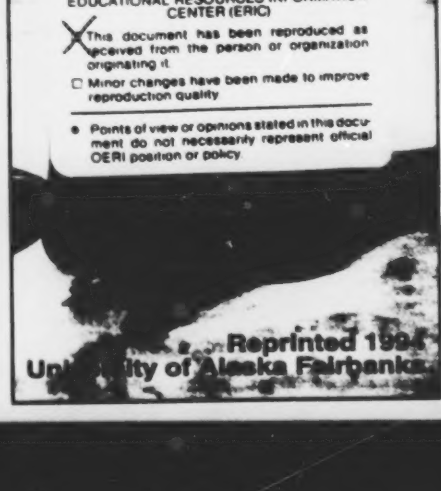

Alaska Sea Grant Report [illegible]

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Alaska Sea Week Curriculum Series: VII

Marine Mammals, Coastal and River Issues

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October 1984

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Introduction

Sea Week is a celebration. It's one of those rare school programs that can saturate a class with learning opportunities without intimidating a single child. The hundreds of teachers now participating in Sea Week throughout Alaska have found it to be a highlight of the year--a week of delight and awe, intrigue and excitement. It's a week that translates classroom science, mathematics, language, history, social studies, art and music into the crash of a wave, the scuttle of a crab, the drift of a kayak, the bark of a sea lion, the taste of smoked salmon, the scent of a pier. The only frustration we've found is among educators who discover that a week isn't enough. Many teachers have expanded their programs to a month. Several have simply given up on trying to confine Sea Week to a time, and now make use of the curriculum throughout the year. However you design your own program, we're confident that its primary ingredients--Alaska's kids, rivers and coastlines--come to you satisfaction guaranteed!

Marine Mammals and Coastal Issues is the seventh of seven Sea Week curriculum guides. This book lends itself well to a sixth grade curriculum, but is not "locked" into that grade level. It has been adapted effectively to secondary and adult education. Several factors are responsible for the versatility. One is that while student activities in each book are at grade level, the teacher background materials are written at university level, and can be transferred to the classroom at any level the teacher desires. Another is that the curriculum encourages the use of community resource experts, who can gear their talks and tours to anyone from preschoolers to retirees. A third reason for the flexibility is that many of the student activities have latitude. When in Volume VI the guide suggests building model boats, for instance, it includes the pattern for a paper cutout. But the same activity can be used by high schoolers constructing complicated models, or by adult students trying their hands at building an actual kayak!

The lives of all Alaskans are touched often by the sea--literally, aesthetically, productively. To begin with is the sheer immensity of the Alaska coastline. It stretches and twists, pounds and lies placid along two oceans and three seas for 6,640 miles--more than half that of all the contiguous United States. Islands, inlets, bays, fjords and delta regions add another 28,000 miles of saltwater shoreline for a total of 34,640 miles--a distance almost equal to twice the circumference of the earth. Alaska's continental shelf covers more than 830,000 square miles, more than 75 percent of the U.S. total. More than 90 percent of the fish caught in the U.S. come from Alaska waters. And Alaska's coastal zones, both onshore and offshore, contain an estimated 75 billion barrels of petroleum and 380 trillion cubic feet of natural gas--amounts that would equal 50 percent of the nation's remaining petroleum reserves.

More than three-quarters of Alaska's almost half-million people live along its coastline. Their careers are generally sea-related. Grocers sell to the fishing fleet, lumbermen float their log rafts overseas to the mill, real estate salesmen get more money for property with an ocean view, and school teachers find that one of the most effective ways to spark interest in a child's eyes is to turn those eyes seaward.

The bulk of Alaska's culture is so closely interlaced with the sea that in many cases the sea is Alaska culture. The seven volumes of the Sea Week Curriculum Series escort youngsters through the crafts, arts, music and oral and written literature of the coastal Haida, Tlingit, Koniag, Chugach, Aleut, Yupik and Inupiat to the poetry, literature and artwork of Alaska today.

And even the lives of that one-quarter of Alaska's folk who don't live along the coastline are linked to the sea. They are consumers of sea products, of course; and beneficiaries of seacoast oil wealth, and even occasional visitors to the sea. But more importantly, they are linked to the sea by Alaska's myriad rivers and wetlands. Alaska's vast interior, which its inhabitants call "The Golden Heart" of the state, includes hundreds of thousands of miles of rivers and streams, and 390,941 square miles of wetlands. That's two thirds of the state, all linked to the coastline by freshwater systems that serve as nurseries for Alaska's salmon and waterfowl, as transportation arteries to and from the coast, and as the nutrient-rich replenishers of the ocean currents.

Because of such interconnections between wetlands and the sea, with this edition the Sea Week Curriculum Series has been expanded to include units on Alaska's wetlands and the traditional Athabascan and contemporary peoples who inhabit them.

The resulting series is the foundation of the most comprehensive marine education program ever developed in the Northland. We hope that you will find it as valuable and motivating as it is intended. We hope, too, that through Sea Week, the youngsters of your classrooms will come to more deeply respect and appreciate the environments for which they will soon be responsible. The insights they gain in your classrooms will become the votes and legislation, the lifestyles and attitudes, the wisdom and understanding--the sea harvest--of tomorrow.

Tips for Teachers

Welcome to Sea Week! Here's a checklist of tips designed to help familiarize you with the contents of Marine Mammals, Coastal and River Issues, and to assist your Sea Week planning.

- If you haven't scanned the book already, we suggest you get a sense of its format by glancing through the Table of Contents, the different units containing teacher background and student activities, the student worksheets, and the bibliography at the end of this volume. Note that each unit begins with a list of objectives that specify which activities are designed to accomplish those objectives, as well as a key picture that can be used to introduce, review or evaluate the unit.

- Student worksheets have been placed together at the end of the book, numbered to correlate to the units they complement. Thus Worksheet 1-A is the first worksheet (A) listed among the activities in Unit 1; Worksheet 2-C is the third worksheet (C) assigned in Unit 2, and so on.

- Many more ideas are included than can be used in a week, but we wanted to give you a selection so you can potentially expand to Sea Fortnight, or "Sea Year"! We suggest at a minimum that you do the Community Inventory and Journal Activities (Unit 1); select one of the issues (Units 2-6); do a few review activities (Unit 7); and try Sea Week camping (Unit 8).

- Make lesson plans, selecting those activities most appropriate for your students, with consideration for local history and culture. Survey your students to find out what issue (Units 2-6) they are most interested in exploring. Note that we've included activities to sharpen skills in language arts, science, social studies, math, music, art and physical education, so that all aspects of education during Sea Week can focus on Alaska's ocean, river and wetland environments.

- Plan your field trips or Sea Week Camping experience. Arrange to take parents, older students or resource experts as helpers.

- Check through the "materials" list of each unit, then make, buy, scrounge or order any equipment you might need.

- Order films early!

- Talk to your librarian about books to back up your studies. Suggestions are included in the general bibliography at the end of this book.

In the Field

- Plan at least one field trip. Decide on a place, time and means of transportation. Biologists, long-time residents, parents or bilingual staff may have field trip suggestions. Invite one or more of these people to go along on your field trip.

- Develop an outline for your field trip. Suggested inclusions:

  A. Discovery and exploration time.

  B. Structured learning activities.

  C. Snacktime.

  D. Organized games, treasure hunts, litter pickup.

  E. Review of the day's events (which can be as simple as having each student and parent telling what he or she enjoyed most).

  The first hour of the field trip is often the most productive, so you may want to begin with a structured activity. On the other hand, if the class has rarely been to that type of habitat before, you may want to let them explore first, so they will settle down for a more productive, structured activity later. Or you may want to combine discovery time with a structured activity by having students look for certain species and interrelationships. If you're taking a bus, make up a game, or a checklist of things to watch for so as to develop a learning atmosphere for the trip.

- Write a letter to parents. Include requests for field trip assistants, materials, ideas, and permission slips.

Dear Parents:

We are celebrating Sea Week May 6-11. All our classes that week will focus on the sea. We'll be emphasizing marine mammals, coastal and river issues as we solve sea-related math problems; write sea themes; read sea stories; have a seafood snack and take a three-day trip to Halibut Cove. Can you help with any of the following items?:

_____provide a seafood snack

_____assist with a Sea Week art project

_____talk to the class on the following sea themes: ________________

____

_____show the class your collection of ______________________

_____help with Sea Week planning and preparations

_____go on the trip to Halibut Cove

Thanks so much! And happy Sea Week!

I give my permission for ______________________ to go to Halibut Cove for three days (depending on weather) during the week of May 6-11.

____
signature of parent or guardian

- If possible, visit the camping or field trip site ahead of time with your assistants. Explain what you'll be doing and answer questions. (Older students make great helpers, in addition to parents and interested community members.) Field trips generally work best if you can break your students into groups of five to six.

Promote conservation by emphasizing the protection and wise use of natural resources. Ask students how they can help take care of animals and plants they encounter in field and classroom studies. Through their concern for life and habitat, have students develop some rules:

1) step softly and quietly while observing animals,
2) replace rocks or logs after looking underneath (to keep the roofs on animal homes),
3) handle animals gently,
4) fill in holes after looking for clams (to prevent suffocation of the animals next door),
5) do not take live animals or plants away from their homes.

- So that future students can enjoy the area, too, it is a good idea to discourage personal collections of any natural items, living or nonliving. Limit collections to educational purposes, such as art projects or aquarium study. Be sure to return any living animals to their natural habitats as soon as possible. Preserve for classroom specimens only those animals that are already dead.

- Encourage students to leave the beach, river or wetland cleaner than when they arrived.

- Remember safety. For field trips:

1) have a plan for keeping students in groups through a buddy system or adult supervision.
2) Take a first aid kit.
3) Discuss hypothermia.
4) Take matches and tinder for starting a warm-up fire if necessary.
5) Make sure all participants dress warmly and take extra clothes and rain gear (plastic trash bags will do in a pinch, but remind students about the danger of suffocation from plastic).
6) Wear life jackets on boat trips.
7) See Units Seven and Eight for additional suggestions.

In Your School and Community

- One of the best aspects of Sea Week is involving all the students, teachers and community residents, so that everyone works together. The whole school is decorated; one class inspires another; older students do programs for younger ones and vice versa; community residents help with field trips and speakers. An air of excitement pervades halls and classrooms! But don't hesitate to try Sea Week on your own or with just a few other teachers. By next year, when they've had a chance to see what you've done, others will be ready to try Sea Week, too!

- Plan your school's Sea Week at a time best suited to your location. Teachers in southwestern, southcentral and southeastern Alaska are finding it best to consult tide tables and plan beach trips at low tide. In northern, central and western Alaska, Sea Week activities are proving most successful when there's open water, or when they are planned to coincide with a longstanding seasonal activity, such as fishing or whaling.

- Brainstorm Sea Week ideas with other teachers and parents. Use the Sea Week Planning Sheet beginning on Page ___ to list the names of parents and local resource people who can help make your Sea Week a success. You'll find most people are pleased to be asked and more than happy to help.

- Involve your bilingual staff as you identify such community resources as speakers (fishermen, net menders, Coast Guard personnel, boat captains, community elders, artists, musicians) and field trip sites (beaches, harbors, canneries, seafood markets, salmon spawning streams, marshes, hatcheries, museums).

- One or more parents or teachers can be appointed to coordinate speaker schedules, movies and field trip transportation, and to present your Sea Week plan to school district officials for approval.

- Contact your chamber of commerce, village council/borough government, and other community groups, inviting them to sponsor complementary Sea Week events such as festivals, seafood dinners, slide shows, speakers.

- If your school is inland, consider exchanges with a coastal school. Send it a selection of items found on your field trips, a class story, or perhaps photos. Maybe they can send you fish stories, pieces of net, floats, seaweed, beach sand. Most activities in this book can easily be adapted for inland schools. Try to acquire a saltwater aquarium for your school.

- Field trips and other Sea Week activities make bright news features. Consider contacting your local newspaper, television or radio station. Reporters often enjoy going to the beach as much as students do! Provide as much information as possible to all community media, and be sure to present it in a professional way.

Follow-up

- Write thank you notes to speakers.
- Ask students, teachers, parents and community participants to evaluate Sea Week.

  The sea is important to me because...

  To me, the best part of Sea Week was...

  The part of Sea Week I didn't like was...

  My suggestions for making Sea Week better are...

  Overall, Sea Week was:

  ☹ poor 😐 ok ☺ great

- Write a brief report--including sample student work, evaluation forms, and news articles--for your administrators. Send a copy to the Sea Week project coordinator either in your own region or at the University of Alaska, Fairbanks, Alaska 99701. We like to keep informed of what you are doing. And we'll share your good ideas with other students, teachers and administrators.
- Photocopy your lesson plans and stick them in this guide, so you'll be ready for next year!
- If you'd like to learn more, consider requesting a Sea Week inservice or 1-credit course for your school. Contact Alaska Sea Week, Department of Education, University of Alaska, Fairbanks, Alaska 99701; or the School of Extended and Graduate Studies, Outreach Division, University of Alaska, Juneau, Alaska, 99802; or Talent Bank, Department of Education, Pouch F, Juneau, Alaska 99811.

SAMPLE BUS CHECKLIST

COPPER RIVER DELTA FIELD TRIP

(give yourself 1 point for each box checked--
except as noted!)

☐ Copper River Railroad Historical Marker

☐ Eyak Lake

☐ Eyak River

☐ avalanche chute

☐ flood plain

☐ wetland ____________
(name)

☐ pond

☐ braided river

☐ glacial silt

☐ Scott Glacier

☐ Sheridan Glacier

☐ Sherman Glacier

☐ gravel

☐ glaucous-winged gull

☐ mew gull

☐ arctic tern

☐ Canada goose

☐ duck

____
2 points extra if you can identify it!

☐ bear (3 points)

☐ moose (3 points)

☐ toad

☐ eagle

☐ shore bird

____
3 points extra if you can identify it!

☐ eagle nest

☐ sun

☐ clouds

☐ rain

☐ invertebrate ____________
(name)

☐ salmon

☐ stickleback

☐ alder

☐ willow

☐ spruce

☐ berries _________________
(name)

TOTAL POINTS

Seaweek Planning Sheet

Resource People: Speakers, craftsmen, field trip leaders.

Name	Expertise	Phone

Field Trip Possibilities:

Location	Habitat (Beach, river, pond)	Transportation Arrangements

Volunteers: To help with field trips, seafood meals, classroom activities.

Name	To Help With:	Phone

Films:

Call Number	Title	Source	Rating

Books:

Call Number	Title	Source	Rating

Equipment:

Type	Purpose	Source

Unit One
The Values of Rivers, Wetlands and the Sea

Index:

Activity 1: Community Inventory 3
  Worksheets:
  Community Resource Inventory............1A
  Community Objectives Inventory............1B

Activity 2: Coastal Zone Management Simulation Game 5
  Worksheet:
  Alaska Borough Map....1C

Activity 3 : Designing A Symbol and Beginning a Journal 13

Activity 4: Looking Into the Future 14

Activity 5: Careers 16

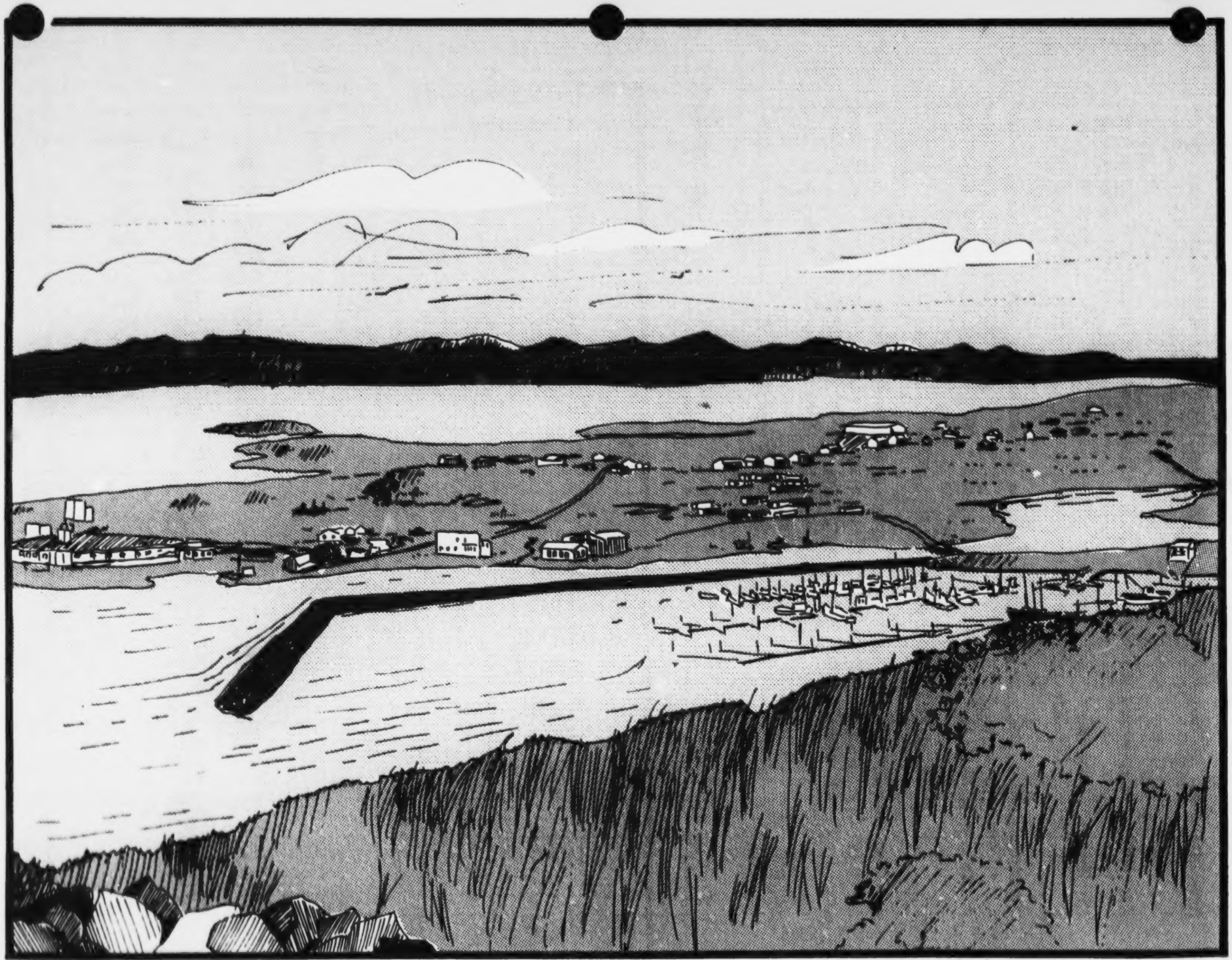
Activity 6: Recreation 18

Activity 7: Food............. 19

Objectives:

To help students:

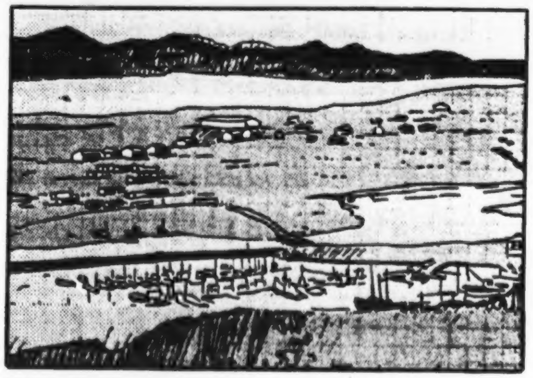
- Inventory and map community resources (Activity 1).
- Predict what the community will look like in 25 years (Activity 1).
- Role play a character involved in coastal zone planning (Activity 2).
- Describe coastal zone management and how it relates to values in the community (Activity 2).
- Design a symbol of rivers, wetlands and/or the sea (Activity 3).
- Begin a journal of Sea Week studies (Activity 3).
- Describe personal preferences for a variety of marine and/or freshwater environments (Activity 4).
- Draw the way each environment will look 25 years from now (Activity 4).
- List 30 river, wetland, or sea-related careers (Activity 5).
- Write a report on one sea-related career that sounds interesting (Activity 5).
- Pantomime a marine or freshwater sport, hobby or recreational activity (Activity 6).
- Diagram an aquatic food web (Activity 7).
- Cook and taste a variety of foods from rivers, wetlands, and the sea (Activity 7).



UNIT ONE: The Values of Rivers, Wetlands and the Sea. Alaskan communities are dependent on the water for transportation, food, minerals and recreation. How to manage Alaska's river, wetlands and ocean resources is a complex and ongoing question.

Seas, rivers and wetlands are some of our most valuable resources. Alaska is especially rich in these aquatic treasures, and students today will play a vital role in their future preservation, conservation and/or development. This unit gives students an opportunity to express their own values, and to identify some of the ways they can and will affect the environmental future of the state, the nation, and the world.

Activity 1
Community Inventory



Background:

One way to understand the value of a community in relation to its ocean, river and wetlands is to inventory what is there. And as students begin to analyze with you what is happening in the community, issues should surface for your localized Sea Week adventure. As students look at the community's history, its present, and its vision for the future, they may discover values to maintain for future generations.

Vocabulary:

- community inventory
- comprehensive plan

Materials:

- felt-tip markers
- large sheets of butcher paper
- area maps
- community planning documents, if available
- speaker familiar with community planning process
- worksheets:
  - ...Community Resource Inventory (1A)
  - ...Community Objectives Inventory (1B)

Procedure:

1. Go through the following Community Resource Inventory either as a class or individually. Assign students to find out more about each of the resources. With the help of local area maps and student research, make a wall map of community resources with butcher paper and felt-tip markers.

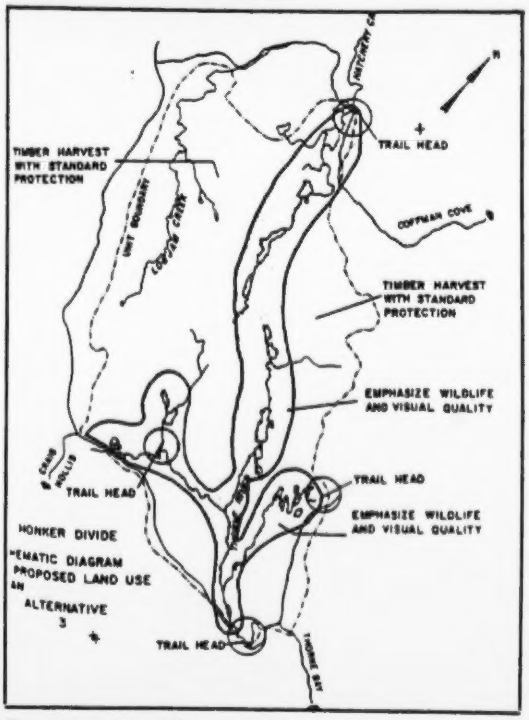
2. Now have students go through the Community Objectives Inventory to check those that sound like good ideas to them. If your community has a comprehensive plan, check objectives in the comprehensive plan.

3. Invite someone familiar with the community planning process (such as a city or village official or council member) to come to your class and explain what has been done so far in your community. Ask them to discuss future developments in your community and ways community objectives can be implemented, such as ordinances, zoning and other regulations. In a coastal community, you may have a coastal zone plan as well as the village or city plan (see next activity in this unit).

4. Now take all your information and make another map of how the class thinks your community will look in 25 years. Students may want to make two maps: one of how they would like the community to look, and another how they think it will look. Students may want to make individual drawings and maps first--in order to later compile them into a class prediction chart.

5. Ask students how they could influence their community to be the way they would like it to be in 25 years. Will any of them run for city council or become mayor? Will someone in their class be on the board of directors for the Native corporation? Will someone be manager of the cannery, president of the local conservation group, information officer for an oil company, or member of the school board? And of course, all of them will be able to vote. These are ways students can determine their community's future. But even right now, students can have an influence! Pick a problem or issue to study in depth. Take one of the succeeding units and apply it to your community--or pick something entirely new. Is a factory, business, mine, dam, road, or park planned for your community? Follow problem-solving guidelines included in Unit 5, Activity 5.

Activity 2
Coastal Zone Management Simulation Game


HUTCHINSON CR.
TRAIL HEAD
TIMBER HARVEST WITH STANDARD PROTECTION
UNIT BOUNDARY
LOGJAM CREEK
COFFMAN COVE
TIMBER HARVEST WITH STANDARD PROTECTION
EMPHASIZE WILDLIFE AND VISUAL QUALITY
CRAIG
HOLLIS
TRAIL HEAD
TRAIL HEAD
EMPHASIZE WILDLIFE AND VISUAL QUALITY
HONKER DIVIDE
HEMATIC DIAGRAM
PROPOSED LAND USE
AN
ALTERNATIVE
3
TRAIL HEAD
THORNE BAY

Background:

While this activity deals with a coastal community, many of the same planning problems can arise anywhere in the state or elsewhere in the nation. So, to familiarize your students with their community and its planning process, as well as to clarify the value of rivers, wetlands and the sea, give this game a try. Later, students might want to adapt it specifically for your community.

The National Coastal Zone Act of 1972 established a program for land and water resources in the nation's coastal zone. For states wishing to participate, this act plans for and manages their coastal areas. Each state develops its own plan, subject to approval of the federal office of Coastal Zone Management on behalf of the Secretary of Commerce.

In 1977, the Alaska Legislature passed the Alaska Coastal Management Act. It established the Alaska Coastal Policy Council to oversee statewide and local coastal planning efforts. The law mandated that the Coastal Policy Council draft guidelines and standards for state agencies and local communities. Currently, communities and boroughs with planning and zoning authority are developing their own coastal plans. The Coastal Policy Council, with the help of local residents, is writing the plan for unorganized boroughs. After the plans are approved by the legislature, by the Alaska Coastal Policy Council, and by the federal office of Coastal Zone Management, each area must follow these guidelines in their development plans.

The coastal zone is defined as "the coastal waters (including the lands therein and thereunder) and the adjacent shorelines (including waters therein and thereunder), strongly influenced by each other...it includes transitional and intertidal areas, salt marshes, wetlands, and beaches." (From the National Coastal Zone Management Act.)

Acknowledgments: Peggy Cowan assisted with the design and characters for this simulation game, adapted from one written by Mary Lou King, Juneau; Gordy Euler, Ellen Searby and Judith Anderegg, Alaska Coastal Management Office; and David Dall, Joe Firebaugh, Neil Hagadorn, Kristi Kantola, Elaine Loopstra, Paul McIntosh, Forest Service, Alaska Region.

Vocabulary:

- coastal zone management
- simulation game
- water-related
- water-dependent

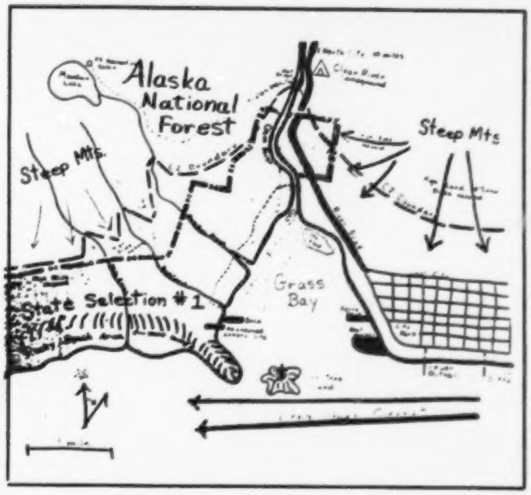
Materials:

- pencils, paper
- felt-tip markers
- butcher paper
- construction paper
- scissors
- straight pins
- copy of local coastal zone plan
- role cards
- six copies of planning commission rating form
- worksheets:
  - ...Alaska Borough Map and Background Information (1C)

Procedure:

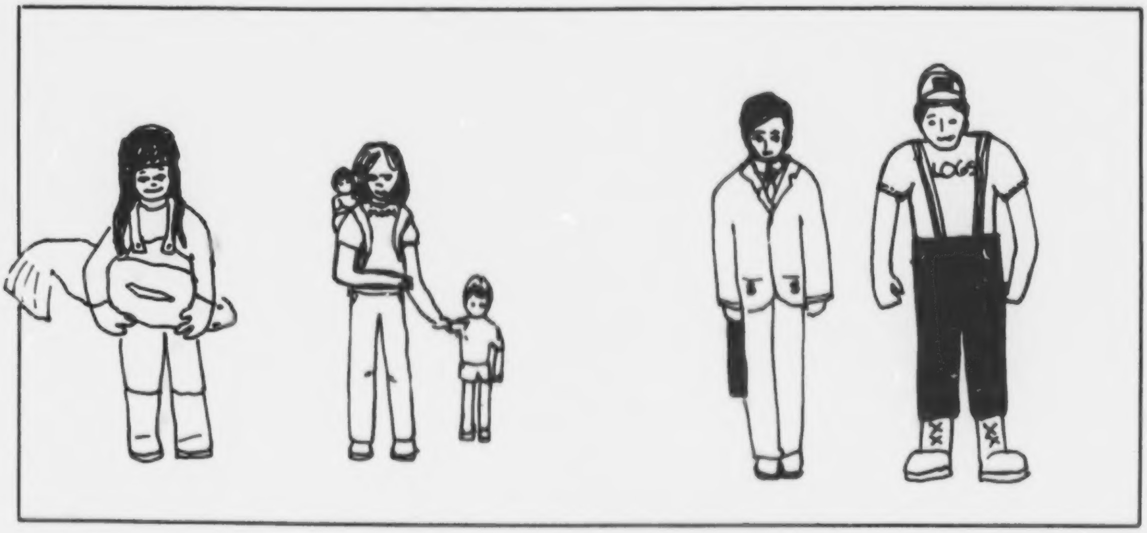
1. Introduce the idea of coastal zone management to the class. Explain that the main benefits are coordination among state and federal agencies, local governments, and local residents. In addition, local control increases as local residents develop the coastal zone plan. Planning assures that water-dependent and water-related activities are given first priority in waterfront development. Industrial and residential areas can be separated. In addition, local concerns, such as fish and wildlife habitat, estuarine productivity, subsistence hunting and fishing, and recreation can also be included in the Coastal Zone Plan.

2. Distribute copies of the Alaska Borough Map and Background Information. Have students read the background information and become familiar with the map. Explain that the class will be preparing different alternatives for a planning commission.



3. Divide the class into five or six groups of five students each, with each group responsible for creating a plan for the state-selected land. Each group then presents its plan to the planning commission. Kay Pearson, 6th grade teacher at Whitecliff Elementary in Ketchikan, finds that it works well to give students overnight to come up with their plans.

Here is a list of what each group is in favor of developing on state-selected land, as well as a list of roles within each group. Be sure students understand that these roles are only brief outlines. Students should be encouraged to expand them, based on their own experiences and sense of humor.



Airport

Pat Piper - pilot, guide
Fred Follett - local businessman, politician
Gary Gustafson - construction worker
Bill Black - local oil and gas supplier
Penelope Peabody - school teacher

Marina

Johnny Hooker - sport fisherman
Jane Fisher - commercial fisherman
Dan Dockett - harbormaster
Nellie Nielson - bar owner
Dr. Winkle Van Rip - physician

Homes

Terry Sales - real estate agent
Mary Castle - young mother
James Green - banker
Barry Buckley - taxpayer
Polly Parrot - telephone company manager

Shopping Center

John P. Morgan - developer
Patty McDonald - high school student
Joe Caputo - taxi driver
Rita Remmington - secretary
Jerry Price - store owner

Park

Sandy Eider - biologist
Pete Gill - commercial fisherman
Ole Olsen - old timer
Susi Demmert - subsistence hunter and fisherman
Will Foster - bus driver, teacher

Logging Mill

Maria Kompkoff - Native corporation president
Perry Peavey - logger
Ron Ionowa - Japanese businessman
Wilma Woodsey - forester
Harry Hackett - unemployed

COASTAL ZONE PLAN ROLE CARDS

Pat Piper- Airport

Pilot and guide who believes the airport would be just what Yakataga City needs. Clients could easily get in and out of town, and local fishermen could more easily use the fish spotting services of local pilots.

Fred Follett - Airport

Businessman and politician who thinks an airport would be great for quick trips to Juneau and allow him to get special order goods for his discount store.

Gary Gustafson - Airport

Construction worker who would like to help build the airport. He also feels that airport might encourage other building projects. Furthermore, a road on the other side of the bay would mean he could drive to go hunting and fishing.

Bill Black - Airport

Oil and gas supplier who sees business improving if planes start coming into Yakataga City. Besides, maybe he will be able to get a small plane for quick shopping trips out of town with his wife.

Penelope Peabody - Airport

School teacher who just can't wait to get out of town more often so she can get away from her students. She does like to go clamming, though, so the park is appealing and she also thinks a marina would be fun because she'd probably use it to go boating more often.

Johnny Hooker - Marina

Sport fisherman who wants a marina so he and his friends can keep their boats in the water. The present harbor is too crowded and if there were a marina, a lot of his friends from Anchorage could come down for weekend parties.

Jane Fisher - Marina

Commercial fisherman who foresees an increase in whitefishing and the need for more boat slips. She would also like to see more homes built, too, as she's tired of living on her boat.

COASTAL ZONE PLAN ROLE CARDS

Dan Dockett - Marina

Harbormaster who wants to start a marina, now that he's experienced in running a harbor. He just inherited some money from a rich aunt and he needs to invest it.

Nellie Nielson - Marina

Bar owner interested in more business. Doesn't like her present location. Things have slumped way down lately and she hasn't been able to take her usual two-month winter vacation down south. A marina would be a great place for a bar and might attract a lot of weekend parties, plus summer tourists.

Dr. Winkle Van Rip - Marina

Physician who wants a place to keep his boat, and who really enjoyed life at the yacht club back in his home town in Maryland. He is a little concerned, however, about disturbing his favorite bird-hunting grounds near Clam Neck.

Terry Sales - Homes

Real estate agent who would like to have a lot more business. Besides, he says, "Everybody needs a home!" He'd be glad to see a shopping center, too, or at least a quick stop grocery to go along with his subdivision.

Mary Castle - Homes

Young mother who's tired of running up and down the stairs all the time. Rent is outrageous and she'd like to be in a scenic wild area where she could look out the window and have a view.

James Green - Homes

Banker who would be glad to give out loans for the new homes. He might be interested in moving out there himself, closer to some of his favorite fishing holes.

Barry Buckley - Homes

Taxpayer who wants to see the borough expanded so his taxes won't be so high. Nothing gets him more angry than that yearly tax bill, knowing that it only goes to support government.

COASTAL ZONE PLAN ROLE CARDS

Polly Parrot - Homes

Telephone company manager who's anxious to expand sales so she can win a free trip to the Caribbean.

Rita Remmington - Shopping Center

Secretary who wishes the local clothing stores had more of a selection. Thinks a shopping center would be great--just like the big city.

Jerry Price - Shopping Center

Downtown clothing store owner who's ready for a change. He would like to get out of his old, somewhat rundown building and into something new. But he hates to see his favorite moose-hunting area disturbed.

Sandy Eider - Park

Biologist who's really worried about the possible loss of the Clam Neck wetland. It's one of the very few along this stretch of coast, and very important for migrating ducks and geese. Salmon spawning in the area's streams and the productivity of the Chinook Bay estuary might be badly damaged. And this wetland is the only nearby moose hunting area.

Pete Gill - Park

Long-time commercial fisherman who's worried about the loss of the salmon spawning grounds if the area in the state selection doesn't stay as it is. "These streams and wetlands are our future."

Ole Olsen - Park

Old-timer who used to mine up in Red Dog City. Now he just wants the country to stay as beautiful as it is--just like the old country. He often enjoys weekend trips with his grandson over to Clam Neck to dig for clams or go fishing or crabbing.

Susi Demmert - Park

Subsistence hunter and fisherman whose family depends on that yearly moose and bird hunt and salmon run. She also clams and crabs and would hate to see any development so close to the archeological sites on Clam Neck and Mummy Island.

Will Foster - Park

Teacher and summer bus driver who enjoys bird-watching on the Clam Neck wetlands. He thinks tourists will be attracted to the area if it is kept in its natural state, and he could run tours over to the wetlands by boat in the summertime.

COASTAL ZONE PLAN ROLE CARDS

Maria Kompkoff - Logging Mill

Native corporation president who sees that the biggest community need is jobs, so she favors using the land to build a logging mill. Nevertheless, she is worried about the loss of the wetlands to subsistence hunting and fishing.

Perry Peavey - Logging Mill

Logger who wants a logging mill so that his future will be assured. He's tired of always seeing the logs shipped away when they could just as easily be processed here.

Ron Ionowa - Logging Mill

Japanese businessman who would like to invest heavily in the logging industry. Lumber is needed for new houses, paper and pulp on his home island of Hokkaido.

Wilma Woodsey - Logging Mill

Forester who would like to see the logging industry expand, but in a well-managed way that protects fish and wildlife as much as possible.

Harry Hackett - Logging Mill

Unemployed worker who would like to see industry come to Yakataga City so he could get a job. His family has been on welfare for way too long.

John P. Morgan - Shopping Center

Developer who feels a shopping center is just what Yakataga City needs. New stores would be attracted and everyone could have "quick, one-stop shopping."

Patty McDonald - Shopping Center

High school student who likes the idea of more stores. Ideally, at least one would sell junk food. She'd like to see a good pizza hangout with video games and a place to buy the latest tapes and records.

Joe Caputo - Shopping Center

Taxicab driver who would enjoy a drive over to the shopping center, as well as needing the extra business. Likes the open road and a chance to get out of town.

4. Pass out role cards, butcher paper and felt-tip markers to each group. Have each student make a name tag out of construction paper, then pin on the tags with straight pins. Have the members of each group introduce themselves. Then have each group elect one person to be on the planning commission. Have the rest of the group take 15 to 20 minutes to make up a plan for the state selection land and develop a three-minute presentation, using the butcher paper and felt-tip markers to make charts or maps in support of their plan. One person should be elected to make the presentation.

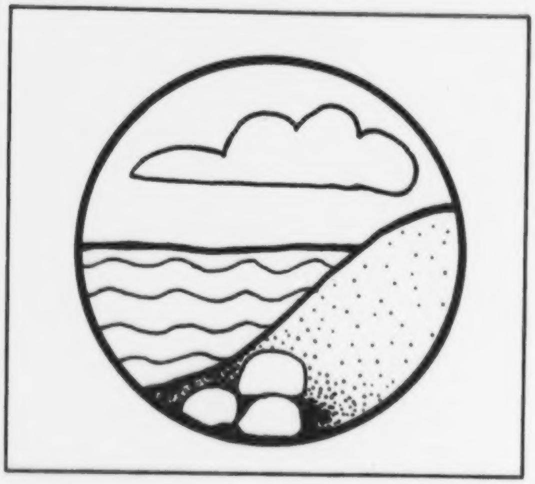
5. While groups work on plans, the planning commission discusses criteria by which to pick the best plan. A sample form is enclosed.

6. Have the commission elect a president, recorder and timekeeper. The president moderates the discussion. The timekeeper insures that each presentation is limited to three minutes. The recorder takes complete notes on the proceedings. Each commissioner should ask two or three questions of the group after each presentation, so that the commissioners can vote with confidence.

7. After the presentations, the commissioners should leave the room to decide on either one plan or a combination of the plans presented. They return to explain their plan to fellow citizens of Yakataga City.

8. Afterwards, have each student write down their immediate impressions of coastal zone management. As a class, discuss the success of the simulation game. How does what's happening in Yakataga City compare with planning and values in your community? Maybe the class would like to attend a "real" local government meeting to see how it compares with their meeting. If possible, obtain a copy of your local coastal zone plan and discuss it with the class. Do they agree with all aspects or would they make changes?

Activity 3
Designing a Symbol and Beginning a Journal



Background:

The process of designing a symbol helps students to think about the value of rivers, wetlands and the sea.

Many organizations and agencies have a symbol or logo to represent, as concisely as possible, their ideas and aspirations. Even t-shirts with mottos and slogans sometimes make social and political statements. By beginning a journal, students record their values, impressions and understandings as they change and grow throughout their Sea Week studies.

Vocabulary:

- symbol
- journal

Materials:

- paper
- pencil
- scissors
- glue
- construction paper
- lined paper
- colored pencils or narrow felt-tip markers
- folders or binders for journals
- sample journals of famous explorers or scientists

Procedure:

1. Announce that as part of Sea Week studies this year, students will keep journals for one week. A week is a concise, obtainable goal. (Students may want to continue for a much longer period after they try it for a week.) Describe or read from some journals of famous explorers, scientists or sea captains. Explain that many times these journal records are the only way we know what life was like in the old days. Many times journals are used as the basis of books. Discuss the advantages of both oral and written traditions. Mention to the class that perhaps someday their children might enjoy reading their journals! As a class, decide on how to construct, bind, and keep journals. Lined paper can be used for the inside, and construction paper, file folders or three-ring binders will hold it together.

2. Make the journals and have each student design a symbol for his or her journal cover that will represent rivers, wetlands, and/or the sea. Refer back to your community inventory. Allow students to come up with their own initial ideas of what's important in both marine and freshwater

environments. They may want to change or modify their symbols as their study progresses.

3. Begin journal entries. Explain that students may want to record impressions and feelings as well as facts learned during Sea Week. Students may want to include artwork, quick sketches, poems, cartoons, news clippings and worksheets. Maybe someday they'll want to turn this material into a book.

4. During each day of Sea Week, set aside some time for students to share journals with classmates. Break the class into groups of two or three students, having them read each others' writing. To encourage each other and to feel at ease in writing and illustrating, encourage them to make mainly favorable comments on other students' journal entries.

5. At the end of Sea Week, set aside a time for students to share their favorite journal items.

Activity 4
Looking Into the Future

Background:

Change is a basic fact of life everywhere in the world, though obviously some communities change much faster than others. An important part of the education process is preparing students for this ever-changing world, especially in solving problems not yet even contemplated today. Students began thinking about change with their community inventory and the coastal zone game. Now they can take another look at change, but on a broader basis. Today's students will decide among preservation, conservation and development goals in the future. Sometimes compromises are possible, but other times the choice is either one or the other: preservation or development. Decisions are based on values, on what is important to people: their survival, their quality of life, their aesthetic and economic well-being. Students need to examine their own values--what is important to them.

Vocabulary:

- preservation

- conservation
- development

Materials:

- five pictures depicting marine and/or freshwater environments from magazines or calendars
- paper
- pencils
- copies of maps of Anchorage and the Cook Inlet Basin, both for now and for the year 2035 (included with the The Alaska Geographic Society's Anchorage and the Cook Inlet Basin)

1. Obtain five pictures of marine or freshwater environments from magazines or calendars showing your own community, the state, the nation, or the world--depending on what you want to emphasize. The pictures should be all black and white or all color (so the brightness of the pictures doesn't influence their decisions) and should range from a highly developed urban area along a waterfront, to a wilderness area adjacent to the coast, to a recreational beach, to a shoreside industry.

2. Number and display the pictures on the wall or bulletin board. Ask individual students to select the area in which they would most like to spend a specified number of hours or days, ranking each picture from five points (first choice) to one point (last choice). Have students write down their individual reasons for liking or disliking each picture.

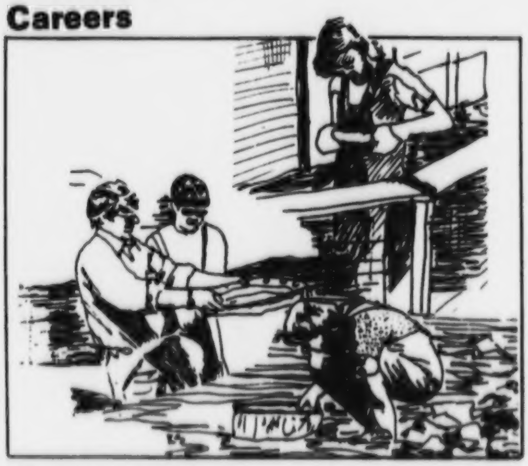
3. Discuss each picture as a class. Total up the points for each picture and graph the results. Compare the values students have applied in making their choices. Are the values similar or different? What contribution does industry make to our lives? Of what value are wild areas?

4. Now have students draw the way they think each of the places pictured will look 25 years from now. How does this compare to what they think their community will look like then? You may want to divide the class into five groups, with each group taking a picture to draw and later making a presentation to the rest of the class. Have individual students write their names on the back of the picture; their age in 25 years; the date in 25 years; and where they think they'll be and what they'll be doing. Adults or parents might want to take these same pictures and draw them 25 years earlier, writing down their age then; what year it was; where they were; and what they were doing.

5. Discuss these changes as a group. How accurate will these class predictions be? What role will students have in decisions on how these pictures will really look? Explain that this year's Sea Week studies will focus on coastal, river and wetlands issues. Students will have a chance to study, debate, and perhaps even influence right now the outcome of some of these issues and how some of these places will look in the future.

6. Just for fun, students might want to compare their predictions with those of The Alaska Geographic Society's artists in the maps of Anchorage and the Cook Inlet Basin, for now and for the year 2035--which are included in the Society's book, Anchorage and the Cook Inlet Basin.

Activity 5
Careers



Background:

Currently nationwide, the marine recreation business ranks as the largest employer of people with ocean-related careers. In the future, as increasing use is made of the ocean's resources, sea-related jobs and skills will be more and more in demand.

In Alaska, the fishing industry supplies 25 percent of all jobs. Additionally, every community is located either on the coast or next to a river--except for Anaktuvuk Pass, which is on a wetland. The vast majority of supplies comes by boat. Marine supply stores do a booming business selling boats, motors and fishing equipment.

Career opportunities include jobs as oceanographers, marine biologists and other scientists, ocean engineers, aquaculturists, mechanics, welders, captains and crew members for boats of all sizes; ship builders, marine social scientists (including economists), lawyers, legislators, executives, public administrators and teachers; marine supply store owners, people involved in the offshore oil and mineral development industries, as well as the Coast Guard and Navy. Language specialists will be needed to assist with the complexities of global negotiations and cooperative agreements, in addition to international trade.

Materials:

- paper
- pencils
- encyclopedias and other reference books
- people involved in marine/ freshwater careers
- chalkboard and chalk

Procedure:

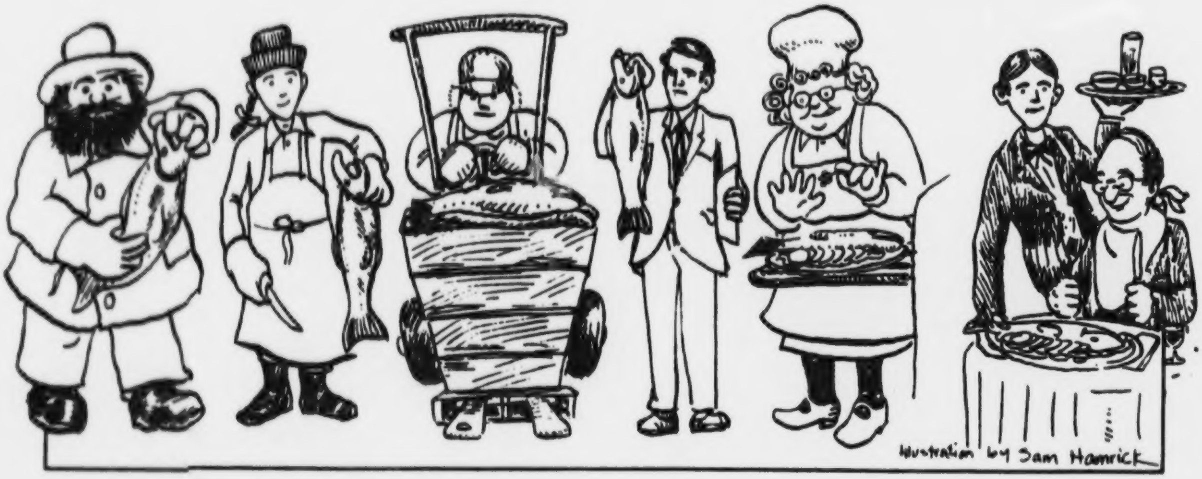
1. Ask students to list local marine and/or freshwater careers. Record them on the board. Do not forget support services such as grocery stores, seafood restaurants and hotels in coastal and river communities. You should be able to come up with at least 30 careers.

2. Have students select one career each that appeals to them and write reports on why they picked these careers. Ask them to describe the education and training needed to prepare for their careers, what an average day on the job would be like, and what they would hope to contribute to their fields. Students may need to either consult reference books or interview people in their chosen careers.

Additional Activities:

1. Social Studies, Language Arts. Invite people in marine careers to visit your class dressed for work. Ask the marine people to be prepared to show students what they do on the job. Have students prepare lists of questions to ask ahead of time.

2. Social Studies, Language Arts. Visit a hatchery, fishing boat, fish camp, seafood restaurant, coastal zone planning office, Coast Guard station, shoreside hotel, or dive shop in order to interview people to see what each career involves.



Activity 6
Recreation

Background:

Fishing, swimming, boating and simply walking along a beach or riverbank are all popular forms of recreation. Water--from puddles to ocean surf--has always held an attraction for people. Photography, backpacking, birdwatching and painting are more recent developments, as are mechanized boats, snowmachines and three-wheelers. Wetlands hunting, berrypicking and clam digging can also be recreational. If fun jobs or chores are included, a great part of a person's life can be classified as recreation.

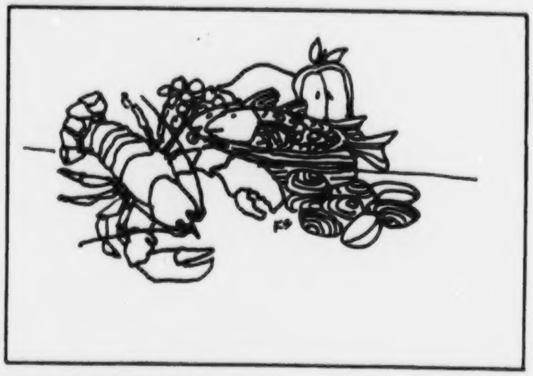
Materials:

- chalkboard and chalk

Procedure:

1. Have students list on the board different types of recreation in your community. Have them mark an "X" by those that are "water-related" and an "XX" by those that are "water-dependent." Don't forget to include wetlands recreation, as well as that in rivers and the sea. Ask students:
   - What is it about water that attracts people?
   - Why is recreation important in this modern age?
   - What are the costs of various recreational activities? What resources are used to manufacture recreational equipment such as skis, snowmachines and dog harnesses?
   - What is the environmental impact of various recreational activities, such as three-wheeler travel versus human foot travel over sand dunes or wet tundra?
2. Have students pantomime some of the different types of recreation, to see if the rest of the class can guess what they're doing. Students may decide to invite to class experts in marine or freshwater recreation to demonstrate their skills.
3. Be sure to stress safety with all types of recreation. (See Unit Eight, Activities 3 and 4, Safety, First Aid and Survival.) If your students are particularly interested in recreation as an issue, see Unit Five, Activity 4.

Activity 7
Food



Background:

One of the best aspects of living on the coast is readily available seafood. Luckily, those who live inland can also enjoy this bounty of the sea through seafood markets, restaurants and grocery stores, and through the salmon that swim upriver to spawn.

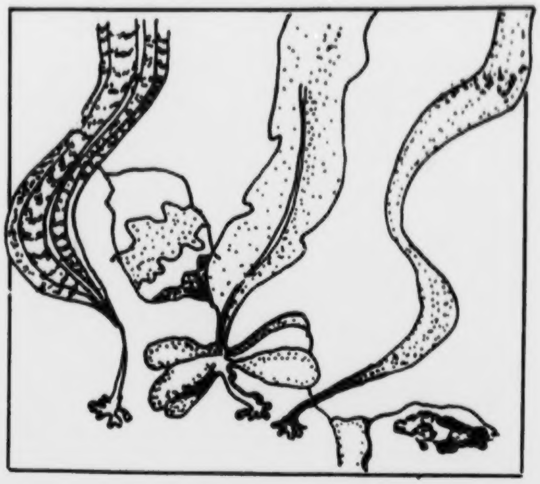
Materials:

- a variety of seafoods
- recipes
- heat source
- cooking and eating utensils
- large sheet of newsprint or butcher paper
- felt-tip markers

Procedure:

1. Ask students about their favorite foods from the sea, lakes and rivers. Then plan a seafood snack, lunch or dinner. Invite parents to donate recipes, to assist with the cooking and preparation, and to taste the results!

2. Try to obtain a wide variety of seafood through parent donations and by checking your local grocery or seafood market. The Oriental section often has seaweed crackers and other delicacies. Remind students that with global food shortages, in the future they may be eating more seaweeds and a greater variety of fish and shellfish. Seaweeds have more vitamins and minerals than land fruits and vegetables. Blue mussels produce more protein per acre than any other land or shore-based food. They are especially easy to farm, using log booms with ropes hanging down, on which the mussels attach themselves. But mussels are very susceptible to paralytic shellfish poisoning (PSP), so be sure you check with the Alaska Department of Fish and Game to be sure your beach is safe before harvesting mussels or clams.



3. Have students cook at least one dish themselves, measuring quantities. Remind students that in general seafood needs only brief cooking to retain its flavors. Canned salmon or clams are easy to cook in a pot on a hot plate. Here's a salmon recipe from the Alaska Sea-

food Marketing Institute, 526 Main Street, Juneau, Alaska 99801. Write for a free recipe booklet, available through this organization.

MILK
CLAMS
CLAMS

HARVEST SALMON CHOWDER

1 can (7-3/4 oz.) salmon
1/2 cup each chopped onion and chopped celery
1 clove garlic, minced
2 tablespoons butter or margarine
1 cup each diced potatoes and carrots
2 cups chicken broth
1 teaspoon salt
1/2 teaspoon thyme
1/4 teaspoon pepper
1/2 cup chopped broccoli
1 can (13 oz.) evaporated milk
1 can (8-1/2 oz.) cream-style corn
Minced parsley

Drain salmon, reserving liquid; flake. Saute onion, celery and garlic in butter. Add potatoes, carrots, reserved salmon liquid, chicken broth and seasonings. Simmer, covered, 20 minutes or until vegetables are nearly tender; add broccoli and cook 5 minutes. Add flaked salmon, evaporated milk and corn; heat thoroughly. Sprinkle with minced parsley. Makes 4 to 6 servings.

4. Use felt-tip markers and a large piece of newsprint or butcher paper to make a large-scale diagram of the food web of your snack, lunch, or dinner menu. Use the illustration as a wall decoration to remind students of the origins of their food. (See Sea Week Volume VI, Unit 2, Activity 5, for a more in-depth discussion of marine food webs.) Students may need to check various reference books to see what the various species eat.

5. As a follow-up, have students brainstorm what it took to harvest, store and prepare the food. For example, the fishing boat is made from trees in Oregon, with metal trim mined in Montana, and with glass windows produced from sands in New York State. Oil-based nylon nets and floats are made from Louisiana oil, and the nets' lead weights come from a mine in Idaho. Then there's the boat's metal freezer, a gas stove, metal pots, clothing, survival suits, electronic communications equipment, and so on and so on!

Unit Two
Marine Mammals

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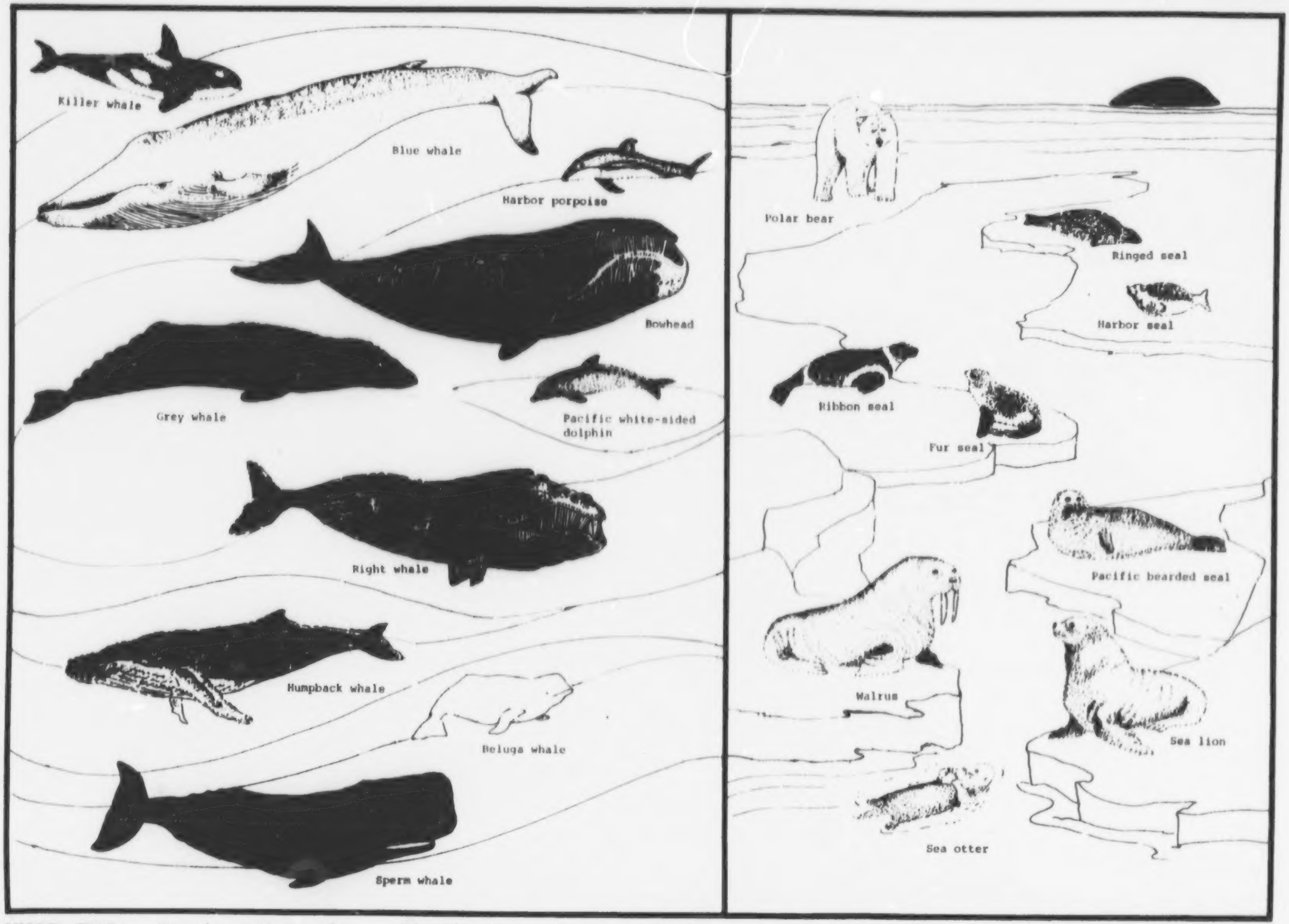
Objectives:

To help students:

- Categorize mammal and marine mammal characteristics by use of a tear-apart worksheet (Activity 1).
- Research the different groups of marine mammals (Activity 1).
- Key out the different whale characteristics (Activity 2).
- Compare whale skeletons to human ones (Activity 3).
- Explain whale adaptation to the ocean environment (Activity 3).
- Measure the length of a blue whale (Activity 3).
- Make a small classroom-sized blue whale and label its adaptations (Activity 3).
- Mark gray whale migrations on a map (Activity 4).
- Graph how fast the class can travel the distance of the gray whale migration (Activity 4).
- Write imaginary conversations about what whales say on their long migration (Activity 4).

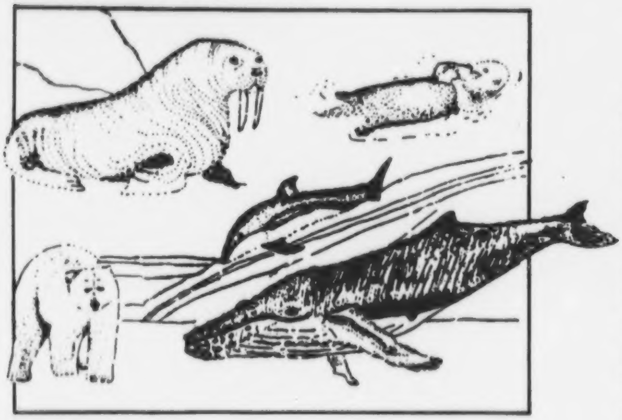
Objectives:

- Read a story about dolphin intelligence (Activity 5).
- Demonstrate a variety of cetacean communications, including echolocation (Activity 5).
- Listen to a cetacean record and a story (Activity 5).
- Write a theme about real or imaginary talk with a whale (Activity 5).
- Make up skits to demonstrate whale first aid (Activity 6).
- Discuss the Marine Mammal Protection Act of 1972 (Activity 6).
- Read or listen to When the Whale Came to My Town (Activity 6).
- Count beans to demonstrate birth and death rates and the difficulties of estimating whale populations (Activity 7).
- Estimate killer whale populations by counting a series of "pods" (Activity 7).
- Read a humpback whale case study (Activity 7).
- Write to whale conservation groups to find out information on present-day whale populations (Activity 7).
- Read early Alaskan whaling history (Activity 8).
- Sing sea chanties (Activity 8).
- Carve and scrimshaw art objects (Activity 8).
- Produce an imaginary TV special on the bowhead whaling issue (Activity 9).


Killer whale
Blue whale
Harbor porpoise
Bowhead
Grey whale
Pacific white-sided dolphin
Right whale
Humpback whale
Beluga whale
Sperm whale
Polar bear
Ringed seal
Harbor seal
Ribbon seal
Fur seal
Pacific bearded seal
Walrus
Sea lion
Sea otter

UNIT TWO: Marine Mammals. Alaska's waters and shores are home to polar bears, otters, walrus, sea lions, eight species of seals, and 18 species of large and small whales--a wonderful portion of Alaska's wildlife heritage, and intricately bound up with traditional Native culture.

Activity 1
Five Groups of Marine Mammals



Background:

Alaska marine mammals include whales, porpoises, seals, sea lions, walrus, sea otters and polar bears. Like all mammals, these animals are:

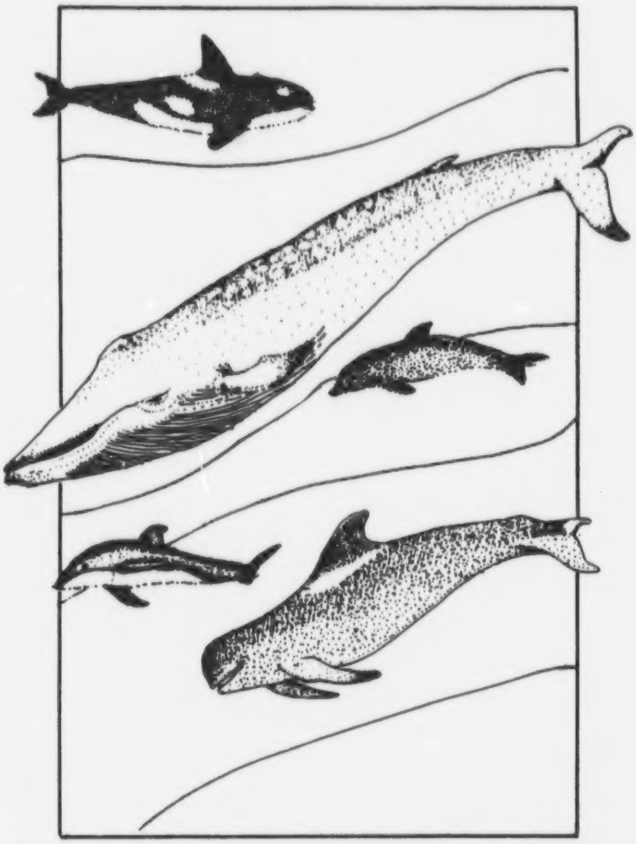
- warm-blooded;
- breath air through lungs;
- have true hair at some stage in life;
- give birth to live young;
- suckle young with mother's milk; and
- have a four-chambered heart.

Other characteristics of marine mammals set them aside. They:

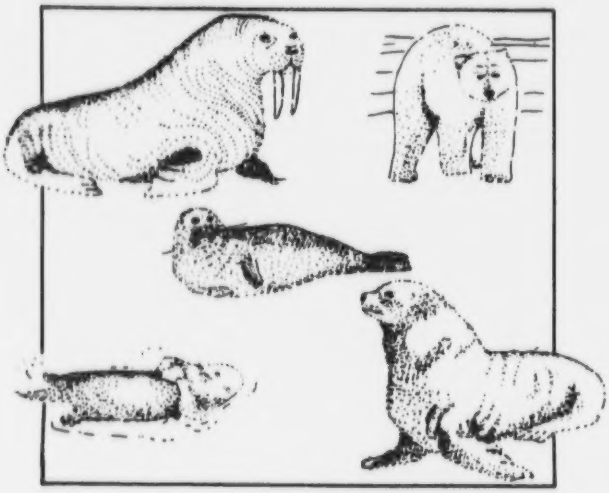
- live entirely or mostly in sea water or on sea ice;
- depend completely on food taken from the sea;
- have anatomical adaptations such as flippers, fins and webbed feet, which equip them for life in the sea or on sea ice; and
- are generally peaceful and unaggressive animals, most of them remarkably intelligent, especially the cetaceans.

Science has not provided a Latin name for marine mammals as a group. They are found in three orders: Cetacea, Sirenia, and Carnivora.

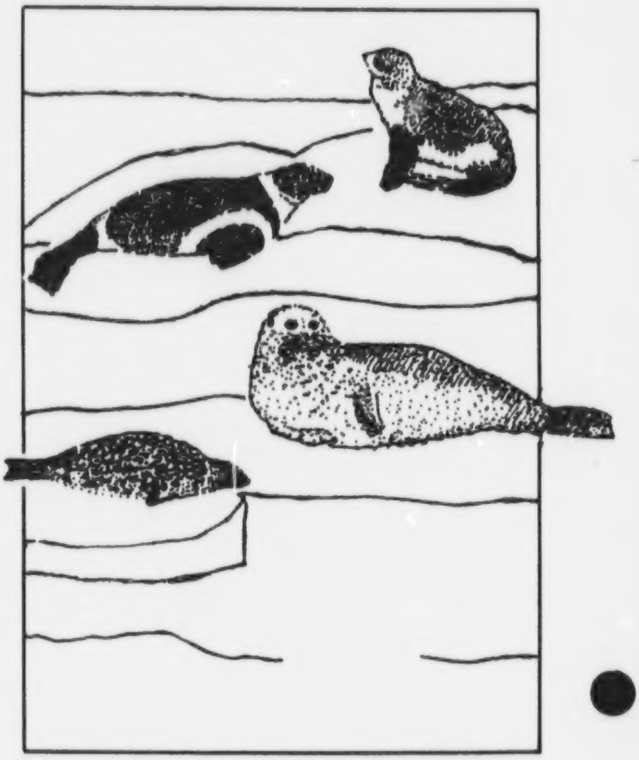
The cetaceans (se-TAY-shuns) include whales, dolphins and porpoises. They are the farthest removed from the land and the most fish-like in appearance. Cetaceans are extremely intelligent. Their learning and reasoning abilities have astounded investigators. This high level of intelligence, combined with their friendly dispositions, makes the cetaceans one of the most scientifically interesting and popular of all animals.



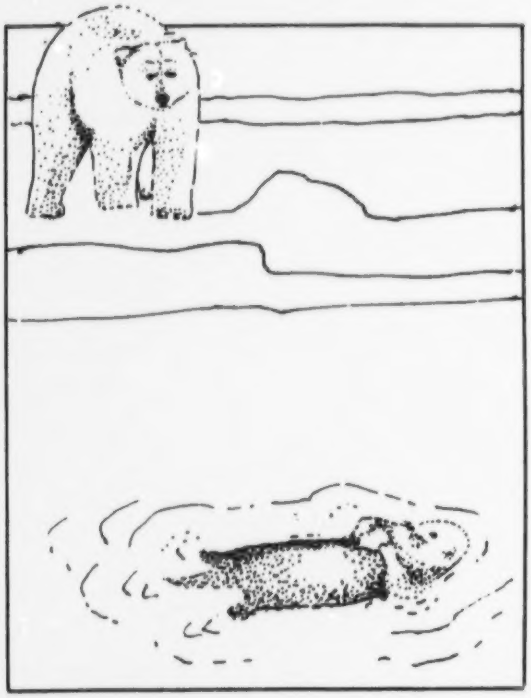
The sirenians have only two surviving members: the manatee and dugong. Steller's sea cows were formerly found in Alaska waters, but they are now believed to be extinct. Sirenians have made a complete adaptation to water, and are not able to survive at all on land. They have no hind limbs, but their forearm flippers can be manipulated to hold food and their nursing young. They are herbivorous, meaning they feed chiefly on plants, and are among the gentlest of all animals. Although the manatee and the dugong are on the U.S. government's list of endangered species, little is being done on an international level to assure their survival.



Within the order Carnivora are five families with marine mammal species, including the seals, sea lions, walrus, polar bears and sea otters. Seals, sea lions and walrus were formerly in a separate order called Pinnipedia. The eared seals (Otariidae) include the northern fur seal and the sea lion. The earless or true seals (Phocidae) are the most numerous. Ringed seals, bearded seals, harbor seals (and the closely related spotted seals), ribbon seals and the northern elephant seal are found in Alaska waters. The walrus is the only member of the family Odobenidae. Pinnipeds, translated "finfooted," are more at home in the water than on land. They still retain their four limbs from ancestral days--in the form of fins. All pinnipeds come ashore to bear their young and to mate. They have few enemies, except for polar bears, killer whales, sharks and humans. The majority prefer the colder waters at the northern and southern extremes of the planet. All feed on fish and other cold-blooded marine life. A few species will attack warm-blooded animals such as penguins and other seals. Pinnipeds are fast swimmers and expert divers. The seals seem to use a form of sonar. Blind seals have been found that are fat and in good condition. (More information on pinnipeds is in Volume IV of the Alaska Sea Week Curriculum Series.)



The ursidae family includes polar bears and the terrestrial brown and black bears. Polar bears spend their summers on the pack ice far above the Arctic Circle. In the fall, they move south with the advancing ice. In winter, they wander widely over the Arctic islands and coasts of North America. Polar bears are expert swimmers and divers, but are usually too slow to catch their prey in water, so they scavenge carcasses, sneak up on seals on the ice, or generally try to outwit the seals. For instance, they will swim under a seal's blowhole and scratch on the ice, causing the frightened seal to plunge through the blowhole into their waiting arms. Only expectant mother bears hibernate.



The mustelide family includes sea otters and the basically terrestrial river otters, weasels, badgers, skunks, martens and wolverines. The sea otter's fur is unusually fine, soft and dense. Sea otters eat primarily urchins, mussels, crabs and clams. Because otters lack the blubber layer possessed by other marine mammals, they have a high daily food consumption. An adult male will easily consume 15 pounds of food a day, nearly one-fourth of its body weight. Otters will usually die if they go without food for three days.

(The background information for this activity was contributed primarily by Zada Friedersdorff, Redoubt Elementary, Soldotna.)

Vocabulary:

- mammal
- pinniped
- Phocidae
- Odobenidae
- Otariidae
- Cetacea
- Odontoceti
- Mysticeti
- Sirenia
- Carnivora

Materials:

- paper
- pencil
- reference books
- worksheets:
  ...Sea Mammal Characteristics (2A)
  ...Pinnipeds (2B)
  ...Cetaceans (2C)
  ...Other Marine Mammals (2D)

Procedure:

1. Pass out the worksheet Sea Mammal Characteristics. Ask students to figure out the differences between sea mammals and all other mammals. They can check their answers in reference books.

2. Assign the Pinnipeds, Cetaceans, and Other Marine Mammal worksheets to encourage further research. Have students check pronunciation of unfamiliar words in the dictionary. (The Pinniped worksheet and the additional activities were contributed by Mike Stichick, Bethel-Kilbuck Elementary, Bethel.)

(Pinnipeds answers: 1. Pinnipeds have thick hides with heavy layers of fat underneath, and their fore and hind limbs are modified to form flippers; 2. (illus.); 3. a. swim, b. open a can, do chin-ups, etc.; 4. Phocidae: ribbon seal, northern elephant seal, harbor seal (and spotted seal), bearded seal (oogruk); Otariidae: northern fur seal, Steller sea lion, California sea lion; Odobenidae: walrus; 5. Western Alaska; 6. tusks; 7. artwork, tools; 8. Bring up the idea of walrus canneries and also tanning of hides. Would this be a source of local income? What difficulties are there in getting a business like this going? How many walrus are there? Are they walrus being overharvested? What happens to the walrus bodies?; 9. useful: enjoyable to see, circus, help keep populations of some sea creatures at lower levels, this is their world, too; destructive: occasionally get caught in fisher nets, eat salmon and herring sometimes, thus competing with commercial fishers.)

(Cetaceans answers: 1. Long-beaked animals are called dolphins and short-nosed forms are called porpoises; 2. Odontoceti: killer whale, harbor porpoise, dall porpoise, sperm whale, bottlenose dolphin, white-sided dolphin, etc., Mysticeti: minke whale, Pacific right whale, sei whale, blue whale, finback whale, humpback whale, gray whale, bowhead whale, etc.; 3. toothed whale; 4. baleen whale; 5. (illus.); 6. small, shrimp-like organisms; 7. their brains are huge and heavily convoluted, they understand and imitate words, learn rapidly, make complex vocalizations of their own, and are known to train their trainers!; 8. They've been overharvested commercially.)

(Other Marine Mammals: 1. 1768; 2. (illus.); 3. huge black body, 25 to 30 feet long, small head, flat lobed tail, paddle-like forelimbs with no "finger bones" and horse- like hooves with bristles on the bottom, no teeth, instead two flat plates grooved together for mashing seaweed; 4. bays and tidal rivers of southeastern United States; 5. looks very much like a manatee, except its tail is more squared off; 6. Their fur traps air and their hairs are hollow. The bottoms of their feet are covered with fur; 7. by collecting urchins, clams, crabs, mussels on the bottom and bringing them to the surface where it lies on its back and feeds, sometimes with the help of a rock to smash open tough shells; 8. Sea otters have longer fur and are much larger; river otters never turn on their backs to feed; sea otters have retractable claws and they can break open shells with a rock; 9. They were overharvested by the old-time Russians who were after thick fur.)

Additional Activities:

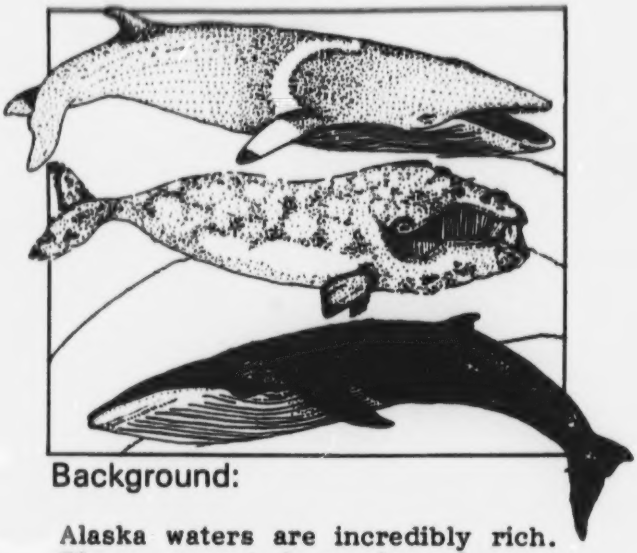
1. Science, Language Arts. Have students pretend your classroom is a large swimming pool filled with water as deep as the door knob or the table tops. Think about where the following things would have to be done by different marine mammals. If they can't figure them out, check a reference book.

    1. getting oxygen (respiration)
    2. getting food
    3. eating
    4. having young
    5. playing
    6. sleeping
    7. getting warm
    8. escaping enemies
    9. getting a drink of water
    10. feeding their young
    11. (Add your own ideas here!)
    12.
    13.
    14.
    15.

2. Art, Science. Have students make a big mural showing the different groups of marine mammals and their daily activities (breathing, eating, escaping enemies, etc.).

3. Music. If marine mammals could sing in our language, they might sing songs about their lives and troubles. Have students write words to such a song. To make it easy, use the tune to "Old Man River" or "Blowin' in the Wind." Organize a seal, sea lion, walrus, whale, sea otter and polar bear chorus to sing the song to an audience.

Activity 2
Name That Whale



Background:

Alaska waters are incredibly rich. They support 9 species of great whales: the sperm, gray, minke, fin, sei, blue, humpback, bowhead and right, plus the smaller killer, beluga, goose-beaked, Bering Sea beaked, giant bottlenose, and narwhal. The best resource on Alaska whales--descriptions, pictures, and range maps--is Alaska Whales and Whaling, published by The Alaska Geographic Society. (Also, check the whale information in the Sea Week Curriculum Guides Volumes I and II.)

"As the whale is great, so to cherish it can be proof of our greatness. Meanwhile, and for a little longer, the great whale glides through the sea, feeling its vibrations and reading its meaning by senses it has gained through eons of time. Had the whale been created only to deepen our sense of wonder, that were enough, for it is imagination that makes us human."

--Dr. Victor B. Scheffer
Alaska Whales and Whaling

Vocabulary:

- baleen (review)
- toothed (review)

Materials:

- scissors
- glue
- large index cards or construction paper
- clear contact paper or lamination machine
- whale books
- worksheet
  ...Cetacean Key (2E)
  ...Beluga Bubble Puzzle (2F)

Procedure:

1. Pass out copies of the worksheet Cetacean Key, which was developed by Laurie Dumdie at the Pacific Science Center in Seattle. Ask students if they know what a scientific key is. (It's a way to identify a plant or animal by making a series of choices.) Review the terms "baleen" and "toothed."

2. Have each student cut out the whale pictures and glue them to large index cards or construction paper. Then they can use the key to figure out each species. Have them place the name match each one with its name and then check through whale books to see how well they did. Once everyone is sure of the identifications, glue the names on the back and cover the cards with clear contact paper.

3. Use the cards as flash cards, to see if students can identify the whales without the key.

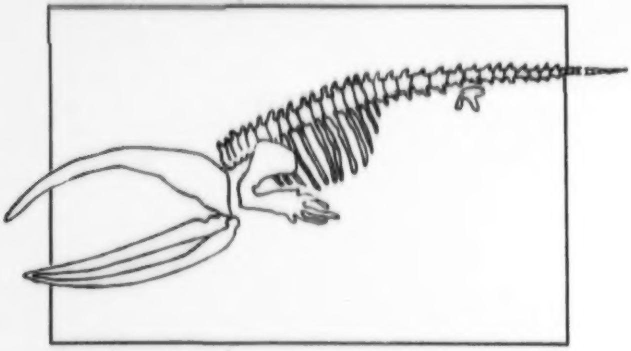
Additional Activities:

1. Art, Science. Have students draw and make up cards for the other Alaska whales: minke, fin, sei, goose-beaked, Bering Sea beaked, giant bottlenose, narwhal.

2. Language Arts, Science. Have each student take a whale, research it, and make a written or oral presentation to the class.

3. Language Arts, Science. Have students make up bubble puzzles for the different species of whales, like the one enclosed that Don Gillespie in Koyuk made to go with the Beluga information sheet from the Alaska Department of Fish and Game Wildlife Notebook Series. Students can make their puzzles from marine mammal books that you have in your classroom. (Answers: 1. Color; 2. largEst; 3. fronT; 4. Adult; 5. arCtic; 6. bEring sea; 7. nulAto; 8. salmoN; 9. preServation--which spells CETACEANS.)

Activity 3
Whale Adaptations



Background:

Adaptations are structures or behaviors that allow an organism to be well-suited to the conditions of its environment. Whales probably descended from land animals long ago, as is evident from their skeletal similarities with land mammals. Whales are probably the largest animals that ever have lived on earth. Their huge size makes it impossible for them to live on land, but enables them to keep warm in cold waters. As an animal increases in size, there is proportionately less skin area exposed, and therefore, less heat loss to the environment. Whales also have a thick layer of blubber under the skin to insulate themselves against the cold. They have:

- glands that oil the eye to protect against salt water;
- young born tail first because of their need to be brought to the surface immediately to breathe;
- blowhole on the top of the head so they do not have to bring their whole body out of the water to breathe;
- an echolocation system that is more efficient than sight in a dark environment, especially since water is a better conductor of sound than air;
- streamlined bodies;
- forelimbs modified into flippers;
- external hindlimbs that have disappeared completely;
- a tail that has been modified into a fluke, providing propulsion by up-and-down movements;
- decreased respiration and heart rates for deep dives; and
- an ability to vary their body shapes as they move through the water, reducing resistance and drag.

(This information and the activity were adapted from the ORCA Whales curriculum developed by the Pacific Science Center and Washington Sea Grant.)

Vocabulary:

- echolocation
- forelimbs
- hindlimbs
- adaptation

Materials:

- 100-foot tape measure or measuring sticks
- pencils
- butcher paper
- old newspapers or scrap paper
- stapler
- large felt-tip markers
- worksheet:
  ...Whale in the Water! (2G)

Procedure:

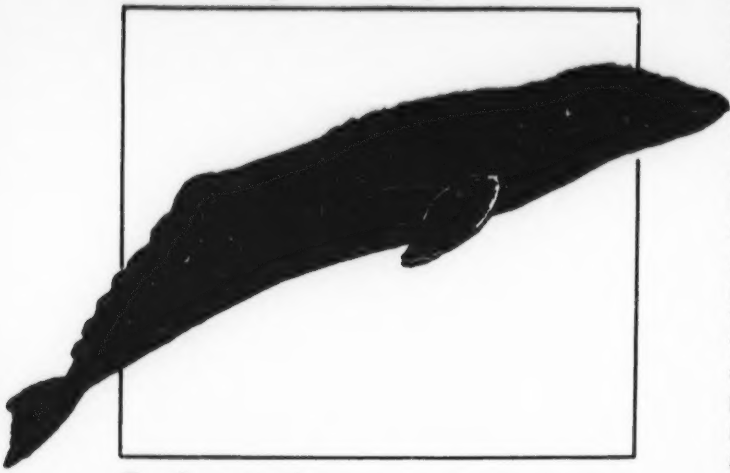
1. Discuss the meaning of adaptation, then pass out the worksheet Whale in the Water! to the students. (Answers: 1. These bones would be hip bones if the whale had legs,

but through years of evolution have decreased in size; 2a. 3, 3; 2b. 5, 5; 2c. they are closely related, the same bones have come to be used for different purposes in humans and whales; 3a. 1 cubic inch; 3b. 8 cubic inches; 3c. 8; 3d. Alaska is filled with examples--think of the large mammals such as moose and caribou that roam around during winter while lemmings and voles hide under the snow; 4a. yes, to protect against salt water; 4b. no, fur would increase friction and slow down the whale in the water; 4c. no, the young need to get to the surface to breathe right away, and it might take a while for the tail to come out; 4d. no, too much heat would be lost; 4e. yes, they can move through the water faster; 4f. yes, to insulate and protect them from the cold; 4g. no, would slow down their speed; 4h. yes, retain fresh water in bodies; 4i. no, other methods can be used to keep warm; 4j. yes, the blood will be able to conserve what oxygen is there; 4k. yes, more efficient than sight when it's dark, and water is a better conductor of sound than air; 4l. no, saltwater tears don't help much when an animal is already in salt water; 4m. yes, help with swimming; 4n. yes, prevent bends, which is common in human deep sea divers, when nitrogen bubbles get into their bloodstream and cause paralysis and death if they ascend too rapidly; 4o. yes, then they can breathe effortlessly without taking their whole head or body out of the water.)

2. Take a hundred-foot tape measure or use measuring sticks to mark the size of a blue whale in the school hallway, side of the building, or on the playground. Mark the measurements with a sign so other classes can see, too!

3. Then make a smaller blue whale for the classroom out of butcher paper. Stuff the insides with old newspaper and staple it together. Label the adaptations on your whale. Make sure it's ready for the water!

Activity 4
Following the Gray Whale



Background:

One of the biggest adaptations is migration. The gray whale makes the longest migration of any mammal--10,000 miles round trip from the warm-water lagoons of Baja California to the Bering and Chukchi seas and the Arctic Ocean. The grays spend the summer (May to September) feeding on one-inch-long amphipods and other small bottom-dwelling invertebrates that thrive on lush plankton growth fueled by the long hours of sunlight. During the rest of the year, the whales eat very little, concentrating on migration and breeding activities.

The gray whale is different from all the other baleen whales. Scientists believe that grays are the most ancient of baleen whales, as well as the sole survivors of a family of whales that was once represented by many species. Grays continue to dominate the choicest of the ocean habitats--nearshore waters. At one time, gray whales were found along the eastern Atlantic and western Pacific coasts and possibly the western Atlantic, but due to heavy onshore whaling operations, only the eastern Pacific population remains. The eastern Pacific populations were almost exterminated in the mid-1800s, when whaling captain Charles Scammon discovered their shallow-water breeding areas in Baja California's coastal lagoons. The whalers took mainly pregnant and nursing females because they were in the shallowest water. And though the grays are extraordinarily fierce when it comes to protection of their young, and will regularly charge boats, the whales were no match for the whalers. Consequently, scientists and whalers at one time thought this great species was extinct, but somehow the whales found each other and began to increase after they were almost wiped out.

Currently, whaling occurs only in the Arctic, where the Soviets take around 180 per year, which they say are for Siberian Natives. A greater danger may be potential development pressures. The Mexican government has declared Scammon's Lagoon a whale sanctuary, but oil is being drilled nearby. If oil is discovered, the natural place to ship it would be from the protected entrances of the lagoons. Heavy tourist traffic along the migration route may represent another threat to the grays. But in some cases whales have begun to interact with boats. Visitors in small boats are sometimes able to approach within 10 to 20 feet of the whales in the breeding lagoons. And recently, certain whales have come right up to the boats, rubbed against them, and even permitted themselves to be petted!

After spending more than two months (November-December) on the breeding grounds, the whales swim northward until they reach the waters of the Bering and Chukchi seas in May or June. They stay fairly close to shore on their way north, but not as close as on the southward migration. Vancouver Island seems to be the staging area for the crossing of the open waters of the Gulf of Alaska. From here on, though, their migration is a mystery--they are not sighted again until they reach the Bering Sea. They may go through or around the Aleutian Islands.

On the journey back south, they go through Unimak Pass between the Aleutian Islands, commencing their journey in October as the Arctic seas begin to freeze.

How the whales navigate is still largely unknown. They occasionally emit pulses that some people think are echolocation clicks. Navigation is also accomplished by memory and vision. Whales are often observed lifting their heads vertically out of the water in a manner known as "spyhopping," which may enable them to get their bearings on various land marks.

To make the 5,000-mile, one-way trip, the whales must keep moving almost 24 hours a day, which leaves them little time for sleep! When migrating or feeding, the whales breathe every 10 or 15 seconds before making a long dive. When they get to the Baja California lagoons, they do sleep, lying quietly at the surface, barely awash, head and flukes hanging limply, raising slightly every eight to ten minutes for a slow breath.

Vocabulary:

- migration
- navigation
- echolocation
- endangered
- extinct

Materials:

- butcher paper
- felt-tip marker
- paper
- pens
- Pacific coast map
- worksheet:
  ...Gray Whale Migration (2H)

Procedure:

1. Ask students to tell you about the longest trips they have ever made. Then pass out the worksheet Gray Whale Migration. Have them use a Pacific coast map to label their worksheets.

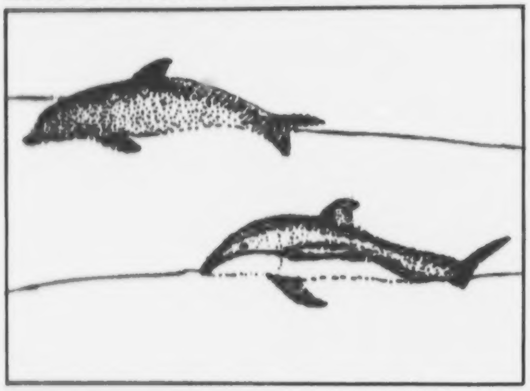
2. Get out the butcher paper and felt-tip pens. Ask the class if they would like to duplicate the gray whale's journey. See if they can equal a whale's trip one way by jogging, biking, swimming, hiking or skiing (for example, 25 students running 1 mile each equals 25 miles). Make a graph or map of the journey with the butcher paper (ask for student help in the design), so that each day they can record how far they moved the day before. (A class of 25 students each running 1 mile per day would take 200 days for the 5,000-mile migration!)

   Your class may want to join with another class. It's not so important that the end goal be reached as that the process of working toward that goal will give them an idea of how far 5,000 miles is!)

3. Have students write paragraphs on what they think the whales talk about on this long journey. Ask students to quickly jot down what comes to mind. Then have them rewrite, adding actual conversation. Let them critique each other's work in small groups and then polish up their whale fantasy.

(These three procedures were adapted from Gentle Giants of the Sea by The Whale Museum. Write for their curriculum guide for more activity ideas: The Whale Museum, P.O. Box 945, Friday Harbor, Washington 98250. You may also be interested in ordering the Gray Whale Teaching Kit, available with slides or filmstrip from: American Cetacean Society, P.O. Box 4416, San Pedro, California 90731.)

Activity 5
Cetacean Intelligence and Communication



Background:

"We are beginning to discern the outline of another mind on the planet--a mind anatomically like ours, but profoundly different."
--Joan McIntyre
Mind in the Waters

Whales and dolphins have very large and complex brains that make high intelligence or awareness possible. Cetaceans usually live in social groups. They help each other, talk to each other, hunt, feed, and work together. Most knowledge of cetacean behavior and cetacean brains has been drawn from captive dolphins and killer whales. Today there are many more questions than answers about whale intelligence and brain structure. In testing what intelligence is, scientists are limited by their own knowledge and the questions and tasks they can think to ask. Results are biased because of the attempt to apply human standards to very nonhuman species. Whales have a human-like sense of humor, a long memory span, an ability to mimic sounds, an ability to learn quickly, and a social organization. The future offers some most exciting possibilities for us to learn from whales, if we can keep them around long enough.

Cetaceans communicate by echolocation, songs, touching, and body movements. Sound is their primary sense, and they seem to be able to talk with other cetaceans and navigate at the same time. Cetacean sounds have been grouped into pure tones (clear whistles) and pulsed tones (echolocation sounds, faster clicks used for social communication, and mysterious, more repetitive, less well- modulated sounds). The species vary in the amount and variety of vocalizations. Each whistle is individualized, like a signature or name, and species can also communicate with other species.

To echolocate, dolphins and whales send out a series of clicks, which bounce back. By analyzing the strength and character of the echo, dolphins and whales can tell size, texture, speed, location and other characteristics of any object they focus on. Scientists developed sonar by watching cetaceans. Like whales, the ships of today can "see" with sound.

Mind in the Waters, edited by Joan McIntyre, is a good source of information on cetacean intelligence and communication. You also might want to order Whales from Ginn Custom Publishing, as a reader for students.

Materials:

- two wooden dowels, the size of a broomstick
- stopwatch
- tape measure
- scarves or blindfolds for all students
- paper
- crayons or felt-tip markers
- record of whale voices
- books about whales
- worksheet:
  ...Say "Rooo-bee!" (2I)

Procedure:

1. Ask students to relate stories they have heard about cetacean intelligence. Distribute the worksheet Say "Rooo-beee!". Encourage students to do additional research about whale intelligence on their own.

2. Discuss cetacean communication. Cetaceans "see" with their ears more than with their eyes. Although they have very good eyesight above and near the water's surface, it is impossible to see deep in the ocean where there is no light. Explain that cetaceans send out thousands of clicking sounds that bounce off the things around them. Then they listen to the echos from the clicks to tell where they are and what is in their way. This is called echolocation. They have memories of the "sights" they have heard; they can tell the difference between their clicks and those of their friends; and they can send out sounds and listen at the same time.

3. Have students demonstrate cetacean communication. First break the class into pairs. Have each student think of a story to tell. Then have them both start telling their stories, trying to listen and talk at the same time!

Divide the class into groups of six or eight. Have each group close their eyes and walk around very softly calling "hello" over and over. See if the students can tell which hello belongs to which person, and where each person is. See if students can use their sense of sound to keep their "pod of whales" together. (Ideas from Project Jonah)

4. Demonstrate echolocation. Take the class outside. Give one student two wooden dowels and station him or her 50 feet away from the building. Place all remaining students 50 feet from the building and blindfold them. As the first student hits the dowels together, have the blindfolded students listen. Describe the echo. Then give one blindfolded student a stopwatch to start when the dowels are hit together and to stop when the echo is heard. Write down the time it took. Then move 100 feet from building and try this again. Move away at 50-foot intervals and keep recording data. How far is the echo traveling each time? (Twice as far as the distance from the building.) Remind students that because water is denser than air, sound travels five times as fast in water as in air.

5. Demonstrate the importance of two ears in sound communication. Because the external ears of most cetaceans are small and inconspicuous, scientists used to think that their ears were nonfunctional. Nevertheless, the middle and internal ears are highly developed, and many of the toothed whales appear to receive sound through the lower jaws. By receiving sound on both sides of the head, direction can be determined. Divide the class into "porpoises" and "fish." Have the porpoises close their eyes and keep their heads stationary. Have the fish make prearranged sounds and see if the "porpoises" can point to the "fish." Now have the porpoises cover one ear and try the same thing. Is this as easy? (Probably not, because the brain needs to compute the differences between what the two ears hear to determine sound direction. Using only one ear, the only clue to direction is loudness.)

Have the "porpoises" move their heads, repeating the one-ear exercise. Does it help them to orient (find the direction)? Now instruct the "porpoises" to use both ears and move their heads around slowly (they may turn their whole bodies), attempting to be conscious of how the sound changes as they turn towards it or away from it. When they reach the point where the sound seems to come into the two ears equally, they may open their eyes. What are they looking at? (If they have listened carefully, they are facing the "fish.") Have they ever seen animals do this? (Many animals, as well as people, will orient in this way by hearing, and then find the target by eyesight. Dolphins and porpoises probably don't use their sight until after they have zeroed in with their hearing.)

(Procedures 4 and 5 were adapted from the ORCA Whales curriculum developed by the Pacific Science Center and Washington Sea Grant.)

6. Have students listen to a cetacean record and read a book about cetaceans (check the bibliography at the end of this unit). Conclude this activity by having students select one or two emotions displayed or communicated orally by whales, and attempt to illustrate them with paper and crayons or felt-tip markers. (Suggested by R. Brumbaugh, Metlakatla)

Additional Activities:

1. Language Arts, Art, Science. Write and illustrate a pamphlet or book about cetaceans. (Suggested by Rocky Goodwin, Sherrod Elementary, Palmer)

2. Langauge Arts, Science. Obtain a whale movie. Show the movie without the sound. Have students pretend they are on a whale-watching expedition. Have them take notes about observed whale behavior. Then run the movie with the sound and see how well the students did at observation. Did they see things that were not mentioned in the sound track?

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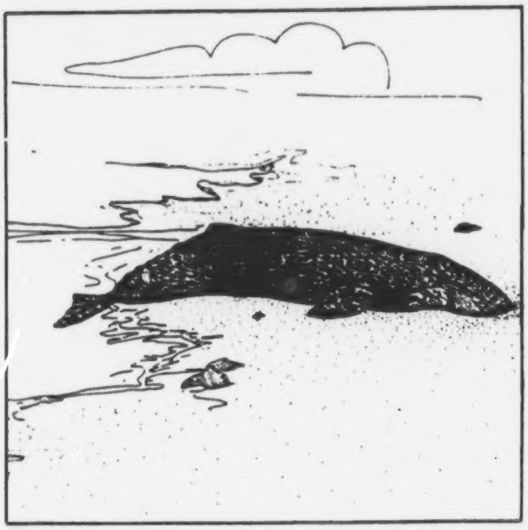
Activity 6
Whale First Aid



Background:

Scientists do not know the reasons why cetaceans often strand themselves on beaches. Perhaps they are sick, or parasites have interfered with their sonar navigation. Though finding a whale on the beach is not too likely, ideally this activity will appeal to student imagination and inspire some creativity. (Information for this activity was taken from the International Fund for Animal Welfare pamphlet "First Aid for Stranded Marine Mammals.")

Materials:

- towels, sheets or cloths
- blankets or tarps
- plastic bags
- lanolin, vaseline or zinc oxides
- When the Whale Came to My Town by Jim Young
- worksheet:
  ...There's a Whale On My Beach! (2J)

Procedure:

1. Ask students what they would do if a whale becomes stranded on a beach near your community. Pass out the worksheet There's a Whale on My Beach for first aid directions. (Answers: 1: gray whale, arrows should point to flippers, tail, flukes, blow hole, eye; 2: 40 feet; 3: roughly 60,000 pounds.)

2. Divide the class into small groups to practice whale first aid on "whale" victims. Some groups may want to work on single strandings, while others work on mass strandings. Have each group prepare a skit for the rest of the class.

3. Discuss the Marine Mammal Protection Act of 1972. It prohibits the "taking" of any marine mammals by anyone except Alaska Natives involved in subsistence activities, people with a permit to take them for research purposes, or fishermen who accidentally entangle them in their nets. The law states that no other killing, harassing, hunting, or capturing of marine mammals is allowed. Collecting any marine mammal, alive or dead, is also illegal. So leave those bones on the beach until you have a permit for them from the National Marine Fisheries Service. Schools can get permits by writing to NMFS, P.O. Box 1688, Juneau, Alaska 99801. Ask students if they can figure out why the collecting of bones, skulls, and other

parts of dead animals is not allowed. (Someone might kill a live animal for its skull and then say it was found dead.)

4. Tell students that if they find a dying or dead whale, they should contact the phone numbers mentioned on the worksheet. If the animal has not decomposed too badly, it is a storehouse of information for biologists interested in marine mammals. A dead whale may serve as a clue to why cetaceans sometimes beach themselves. If scientists cannot come to investigate, they may want your class to take special measurements, and to sketch and photograph the whale. Marine mammal research is still in its infancy. It is difficult to study animals that are out of sight so much of the time. Maybe your class can help make some exciting discoveries. Fill out this card and mail it to: Scientific Event Alert Network, 10th Street and Constitution Avenue, N.W., Washington, DC 20560.

5. Read the story of a stranded whale, When the Whale Came to My Town, by Jim Young.

MARINE MAMMAL DATA RECORD

SPECIES(071,075) ____ NUMBER(202) ____

LENGTH(406) ____ SEX(401) ____ CONDITION(203) ____

DATE/TIME OF OCCURRENCE(095) ____

DATE/TIME OF EXAMINATION(200) ____

NATURE OF OCCURRENCE(201) ____

STATE(102) ____ COUNTY(103) ____

SPECIFIC LOCALITY(104) ____

LOCALITY REMARKS(106) ____

LATITUDE(110) ____° ____' ____" LONGITUDE(110) ____° ____' ____"

VOUCHER MATERIAL(200) ____

DISPOSITION OF SPECIMEN(200) ____

REPORTED BY(450) ____

____ TEL ____

EXAMINED BY(125) ____

____ TEL ____

REMARKS(200) ____

100 107 108 109

Activity 7 Whale Populations

Background:

The International Whaling Commission (IWC) is the only worldwide organization with any responsibility for controlling the whaling industry. Membership is voluntary and numbers 17 countries, including Japan and the Soviet Union, both of which still hunt the great whales even though as of 1981, the Soviets publicly stated they would comply with the 1976 plan to stop their commercial whaling endeavors. Partly because the presence of these two nations forces compromises, critics argue that the IWC represents more of the vested interest in the whaling industry than it does conservation of the whales. Many countries which allow whaling who are not members of the IWC, and pirate whalers indiscriminately take any type of whale in any region at any time. Moreover, the IWC has no power of enforcement, and members can choose not to comply with decisions made at meetings.

The Scientific Committee of the IWC makes estimates of whale populations, setting harvest quotas based on these estimates. The theory is that a population can replenish itself if not too many of its numbers are taken. The Maximum Sustainable Yield (MSY) is the highest number of animals that can be taken from a population and still allow the remaining population to make up the deficiency. Calculating the MSY, however, requires a knowledge of the original population size. Present whale populations are difficult enough to estimate, and estimates of the original populations of the great whales are not much more than educated guesses. These guesses are made on the basis of sightings of whales, a statistic suspect in itself, and by comparing the number of whales caught to the effort involved. Thus, MSY-based quotas can be quite inaccurate.

Conservationists have many other criticisms on the statistical assessments of the IWC. (For more information, see The Whale Manual by Friends of the Earth.) One is that the MSY estimate is a technique used to regulate the fishing industry, but may not be useful to control whaling. Fish have a much higher reproductive rate and can more easily replace their numbers than whales can. There is also evidence that social disruption, such as killing members of a group, may reduce the reproductive ability of whales, and that below a certain population density, whales may never be able to reproduce enough to recover their losses.

The IWC currently bans the hunting of sperm whales, blue whales, right whales, gray whales, bowheads (with exception of limited subsistence hunting by Eskimos) and humpbacks. The IWC places quotas on minke whales, fin whales, sei and Bryde's whales. A 10 year moratorium on all whaling has been suggested to allow populations to recover, but it remains to be seen if the Soviet Union and Japan will agree to such a ban before the remaining great whales become so scarce as to be commercially unexploitable.

(This activity was adapted from the ORCA Whales curriculum developed by the Pacific Science Center and Washington Sea Grant.)

Vocabulary:

- maximum sustainable yield
- law of diminishing returns
- harvest quotas
- International Whaling Commission

Materials:

- Two one-quart jars of dry kidney or pinto beans
- cardboard box about 12"x14"x2"
- acetate about 3"x5"
- tape
- overhead projector
- blindfold
- worksheet:
  ...Humpback Whale Case Study (2K)

Procedure:

1. Before class, make a counting box out of a two-inch-deep cardboard box (or two lids). Cut out a "window" in the top and tape a three-by-five inch piece of acetate on it. Now put a number of beans in the box.

2. Ask students how they would count a whale population. Show them the counting box (ocean), with beans representing the whales. Place the box on the overhead projector. Shake the box around vigorously so the beans move before students have time to count those appearing in the window. On the basis of the beans they can see, can the students estimate the total number? Take their guesses and ask what they are based on. Now try a different number of beans, either a great deal more or less, and repeat the estimations.

   Ask students to describe the difficulties in counting beans.

   Based on this exercise, what does the class think are some of the problems in trying to count whale populations? (The whales move around, you can't tell if you've counted them before or not, they live in areas that we can't always watch, etc.)

3. Talk about the International Whaling Commission (IWC), its make-up and power (or lack thereof), and what statistics whaling quotas are based on. To demonstrate how a population estimate can be based on the energy expended to capture individuals, bring out the counting box again. This time have a blindfolded student "hunting" for beans; that is, picking beans out of the box one by one. They can be put into a jar once they are caught. What happens to the number of attempts to catch a bean as more beans have been caught? Now "improve" the hunting technique: remove the blindfold. (Whaler's hunting techniques were greatly improved by the invention of the explosive harpoon and motorized catcher boats.) Compare the energy needed to hunt now.

Explain the law of diminishing returns, which states that as a resource is used up, it takes increasing time and energy per unit to exploit what remains. There is a point when, because of the scarcity of the resource, it becomes no longer profitable (in terms of capital or energy) to exploit it. This has happened with many of the great whales, which means they have become extinct for commercial purposes. And scientists are worried that once whales fall below a certain population density, they may never be able to reproduce enough to recover their losses.

4. Use beans, once again, to get across the effect of birth and death rates on population growth. Place two one-quart jars at the front of the classroom and divide the students into two groups. Students in one group will each add two beans to their jar, and students in the other group will add three beans at a time to their jar, to represent two different birth rates. Compare how fast the jars fill up. Now demonstrate birth and death rates. Start with both jars full. Have each group add two beans at a time to their jars, but have one group take away one and the other group take away three to represent two different death rates. What eventually happens to the three-bean group? (None will be left.) This is obviously an extremely simplistic model of the great whale situation, but it appears that whales are not increasing their birth rate to balance the death rate. Whalers are spending more time and energy to catch each whale than ever before. Point out that decreasing population density can have a serious effect on the birth rate.

5. Demonstrate the difficulty of gauging whole numbers by having half the class be killer whales and the other half be whale watchers. Have the half that are killer whales go outside the class. The whales should decide how many will re-enter the classroom on the first visit of the pod. Have them enter for 30 seconds, leave again, and then re-enter with a different number. Switch groups after a few visits.

Ask students:

- What problems did the whale watchers have? [It's hard to know if you've counted the same animal before; sometimes they move so fast you can't identify and count them all; you need to write down what you see in order to know how the population has changed; killer whales with their dorsal fins and humpback whales with their humps have distinguishing marks (each is different) but other whales are harder to tell apart, and sometimes you see only a little bit of their fin, so it's hard to even tell the whale species!]
- What kind of information can be gained from this type of study? [Birth and death rates; maternal behavior; social

behavior (who hangs out with who); of feeding habits and movements.]

6. Distribute the worksheet Humpback Whale Case Study for the students to read and answer the questions to. (Answers: 1. One problem is whales getting entangled and causing damage to fishing gear. Solutions might be to reimburse fishermen for damage, or to figure out some way to keep the whales from getting caught. For example, whales seem to be able to "see" certain net mesh sizes and not others. Another problem is the increasing pressure of whale watchers. A solution might be to regulate such activity where whales are congregating or breeding, perhaps by setting up wildlife refuge areas; 2. That there is a need for information on birth and death rates, changes in the population from year to year and during migrations, life history, social behavior, maternal and breeding behavior, knowledge of communication, and identification through photos of flukes that vary with the individual. All this would help in humpback whale management; 3. You will need estimates of the original population size from old whaling records and sightings. Then, comparing the number of whales caught to the effort involved (data obtainable from whalers) gives you a gauge of how the population has decreased. You can now estimate present population size, and from this estimate the maximum sustainable yield (MSY), which is the number of humpbacks that can be taken without further reducing the population. You will also need knowledge of their birth and death rates to determine how fast they reproduce and increase their population. This information may or may not be available from other biologists.)

Arguments such as these are still being presented today to the International Whaling Commission for other whale species.

7. Have students write to the following whale conservation groups for literature and information on current whale populations and suggestions for what they can do if they want to help whale populations:

Marine Mammal Commission
1625 "I" Street
Washington, D.C. 20006

Project Jonah
240 Fort Mason
San Francisco, California
94123

Greenpeace
2623 West 4th Avenue
Vancouver, British Columbia
Canada BCV 6P8

General Whale
9616 McArthur Boulevard
Oakland, California 94605

Rare Animal Relief Effort
c/o National Audubon Society
950 Third Avenue
New York, New York 10022

The Whale Museum
P.O. Box 1154
Friday Harbor, Washington
98250

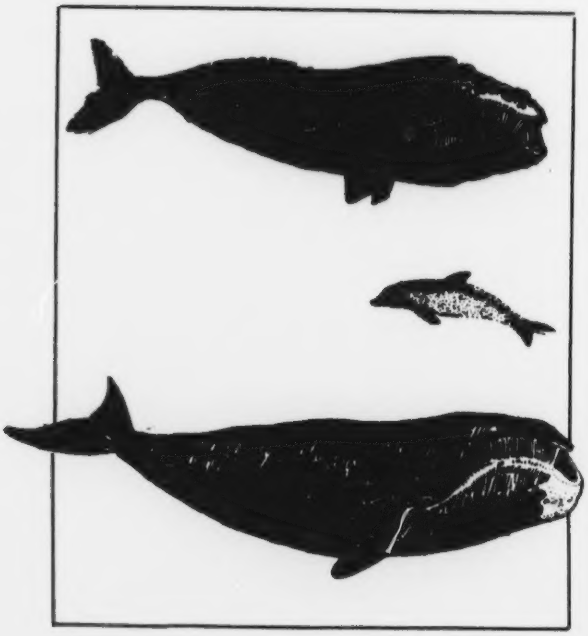
Japanese Embassy
2520 Massachusetts Avenue NW
Washington, D.C. 20008

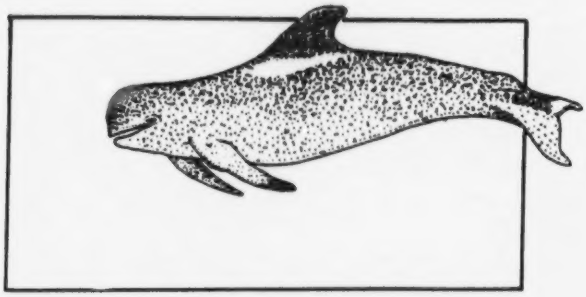
Embassy of the USSR
1125 16th Street NW
Washington, D.C. 20036

Friends of the Earth
124 Spear Street
San Francisco, California
94105

Save the Dolphins
1945 20th Avenue
San Francisco, California
94116

North Slope Borough
Barrow, Alaska





World Wildlife Fund
1319 18th Street NW
Washington, D.C. 20036

Marine Mammal Coordinator
National Marine Fisheries
Service
Dept. of Commerce
Washington D.C. 20235

American Cetacean Society
P.O. Box 2698
San Pedro, California 90731

Whale Protection Fund
c/o Center for Environmental
Education
624 9th Street NW
Washington, D.C. 20001

Animal Welfare Institute
P.O. Box 3650
Washington, D.C. 20007

8. Sing songs about whales. Most sea chanties are about killing whales, but here's one about saving them. →

the song of the world's last whale

by Pete Seeger

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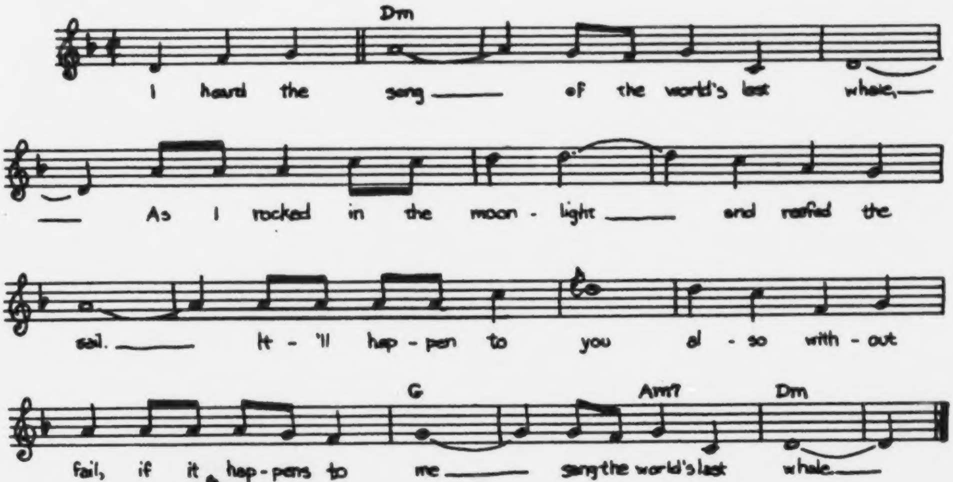

Dm
I heard the song — of the world's last whale, —
As I rocked in the moon - light — and reefed the
sail. — It - 'll hap - pen to you al - so with - out
G
Am7
Dm
fail, if it hap - pens to me — sang the world's last whale. —

1. I heard the song
Of the world's last whale,
As I rocked in the moonlight
And reefed the sail.
It'll happen to you
Also without fail,
If it happens to me
Sang the world's last whale.

2. It was down off Bermuda
Early last spring,
Near an underwater mountain
Where the humpbacks sing.
I lowered the microphone
A quarter mile down,
Switched on the recorder
And let the tape spin round.

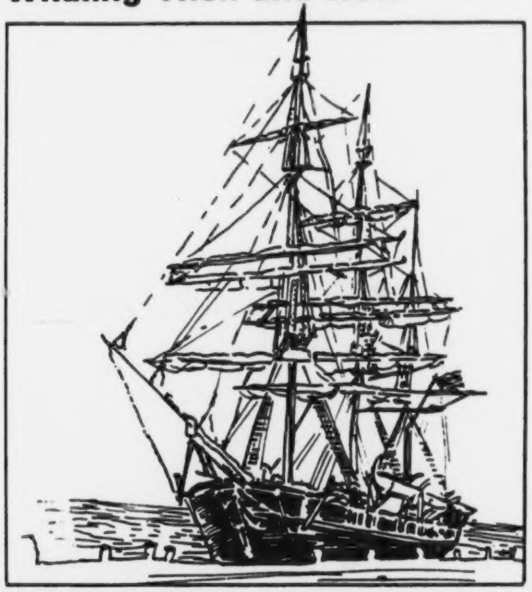
3. I didn't just hear grunting,
I didn't just hear squeaks,
I didn't just hear bellows,
I didn't just hear shrieks.
It was the musical singing
And the passionate wail
That came from the heart
Of the world's last whale.

4. Down in the Antarctic
The harpoons wait,
But it's up on the land
They decide my fate.
In London Town
They'll be telling the tale,
If it's life or death
For the world's last whale.

5. So here's a little test
To see how you feel,
Here's a little test
For this Age Of The Automobile.
If we can save
Our singers in the sea,
Perhaps there's a chance
To save you and me.

6. I heard the song
Of the world's last whale,
As I rocked in the moonlight
And reefed the sail.
It'll happen to you
Also without fail,
If it happens to me
Sang the world's last whale.

Activity 8
Whaling Then and Now



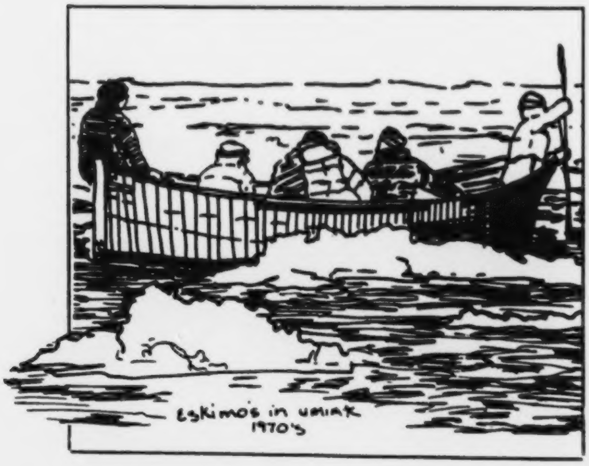
Background:

Whaling is an old tradition in human history. Documented drawings, estimated at more than 12,000 years old, depict men with harpoons hunting whales. The Basques began whaling in the Stone Age, and by the 8th century A.D., they had developed organized hunts in the Bay of Biscay.

They were efficient enough to have driven their prey increasingly farther into the Atlantic. They may even have gone as far west as the New World, reaching the North American shores long before Columbus.

During the 16th and 17th century, the German, English and Dutch joined in the hunting of the great whales. The slow-swimming right whale was the easiest to catch and therefore the favorite whale of these early whalers (hence the name "right"). They were killed by the thousands.

About this same time, the Pacific whales were also hunted by Eskimos, coastal Indians and the Japanese. Methods varied, but they usually used poisoned harpoon heads. Floats were sometimes attached to tire the whale. Eskimos used umiaks or kayaks for the hunt. A large whale provided much-needed food, and could feed an entire village for weeks, as well as providing oil for lamps, leather for clothing, and numerous other products. Not many whales were killed and many men died in their attempts to feed their village.



During the 19th century, the United States dominated the whaling industry. At its peak in 1846, the Americans sent out a fleet of whaling ships almost entirely from the New England cities of Nantucket, New Bedford, Fairhaven and other smaller towns along the East Coast.

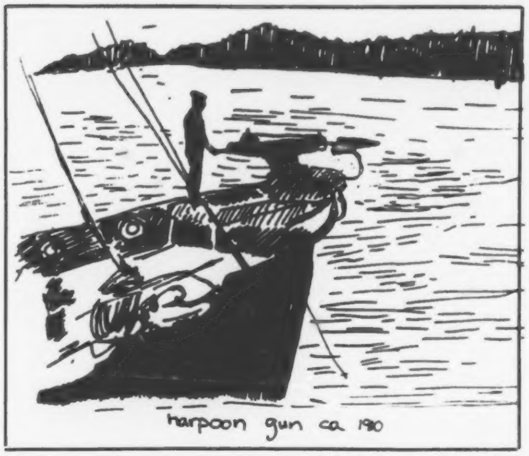
The actual number of whales killed during this period will never be known, but it must have been enormous. Some records were kept, however, which give an idea of how extensive whaling was in early America. The period from 1835 to 1872 was the industry's most productive time, with an estimated 290,000 whales killed.

The two inventions that made this period so productive were the harpoon gun and the exploding tip. In 1840, a Scot named William Greener invented the first harpoon gun. Until this time, the harpoon had been hand thrown, like a spear, by a man standing in a small wooden boat. Even with this new weapon, many whales escaped when the harpoon pulled out or the rope broke. About 15 years later, however, Svend Foyn, a Norwegian, made the harpoon gun even more deadly by devising a delayed explosive tip. A few seconds after the harpoon entered the whale, the explosive charge released, usually killing the whale instantly if it entered anywhere near a vital organ.

Although the Atlantic whaling fleet was the largest, the whalers in the Pacific also killed huge numbers of whales. For countless centuries, the annual migration of as many as 15,000 California gray whales had proceeded along the North American coast. In 1857, Captain Charles Scammon discovered a large lagoon on the west coast of Mexico that was filled with gray whales. The breeding and calving whales in this and other bays along the coast proved to be easy prey.

By 1890 the gray whale was close to extinction, and the American whaling industry, particularly in New England, was disintegrating. Many whaling ships had been lost during the Civil War in the 1860s. In 1871, more than 30 ships were crushed by Arctic ice during a single whaling expedition near the Alaska coast.

The crushing blow to the whaling industry in the United States, however, had nothing to do with the loss of ships. Petroleum, discovered in the 1860s, began to replace whale oil as a lubricant and fuel. Baleen was replaced by the invention of the flexible steel spring in 1906. Whaling, of course, did not end. Instead, it became more mechanized and moved into a different era.


harpoon gun ca 190

The era of modern whaling actually began in 1925. In that year, the first factory ship was launched. Each factory ship was accompanied by several catcher boats, which did the actual killing. The introduction of these new ships meant that the flensers (the men who cut the whale) no longer needed to stand on the edge of the ship or on the whale carcass. This was a very risky job and many flensers fell to their death. The use of the factory ship also meant that, since the dead whale was brought into the ship and cut up inside, there was less loss of the dead whales from storms or shark and orca scavenging.

Though there were fewer whaling fleets, their efficiency was greatly increased. By the 1930s, the whaling nations began to realize that if the industry were to survive, they must put some curbs on the number of whales killed every year. Many agreements were made at this time, but the number of whales killed was still high. Between 1925 and 1930, almost 50,000 whales were taken. In 1938 alone, more than 54,000 of the great whales were killed, and this figure does not include the smaller whales and dolphins.

In 1946, the International Whaling Commission (IWC) was formed by the whaling countries of the world in an effort to regulate the killing. Over the years some whales were protected, but this only happened when their numbers became seriously low. Because there were fewer whales to be hunted each year and because of the cost of building and maintaining the huge ships, the number of whaling fleets and the number of countries involved in whaling dwindled. In the Antarctic alone, 41 factory ships were operating in 1931. By 1964, there were only 23 in all the oceans of the world. Nonetheless, 63,000 whales were killed in 1964. But this was a drop from the peak year, 1962, when 66,090 were taken. As of 1980 there are only nine factory ships left, run by the Japanese and the Soviets, though a number of countries still operate from land-based stations. In addition, pirate whalers from non-IWC nations claim to be independent and ignore all IWC rulings. They will kill any whale they can find, protected or not, including females with calves.

Whales are used for pet foods, leathers, cosmetics, fertilizers, lubricating and cutting oils in the textile and leather industries, candles, glue, and oil for human consumption. Whales are used for a variety of other products, too. But we can currently synthesize all of the products made from whales, as well as substituting other foods for the meat they provide. Many biologists are pushing for a 10 year moratorium on whale hunting, so that whale populations can be more accurately gauged and given a chance to recover.

(Material for this background was adapted by permission, from Gentle Giants of the Sea by the Whale Museum. Detailed information on whale history, products and populations can be found in The Whale Manual by Friends of the Earth. Alaska history of both commercial and subsistence whaling is recorded in Alaska Whales and Whaling, published by The Alaska Geographic Society.)

Materials:

- paper
- pencils
- sea chanties
- Clorox bottles or wood pieces or soft-fired clay whale teeth
- sandpaper
- wood-carving knives (if you are using wood)
- heavy-duty scissors (if you are using plastic Clorox bottles)
- a large needle for each student
- paper towels or rags
- map of Alaska
- map of the world
- copy of Typical Cost of a Whaling Voyage
- sample ivory etchings and carvings
- local scrimshaw and ivory carvers
- worksheets:
  - ...After the Whale! (2L)
  - ...Blow Ye Winds in the Morning (2M)
  - ...Old-time Whaling Puzzle (2N)

Procedure:

1. Ask students to relate what they know about whaling history. Point out to students, on a world map, the route of the Yankee whalers from New England: around the tip of South America, up to Hawaii where they rested and resupplied, then north to Alaska waters. Then pass out the worksheet After the Whale!. (Answers: 1. these dates should be incorporated in the timeline 1835, 1848, 1849, 1852, 1853, 1854, 1858, 1865, 1870, 1871, 1876, 1868-1880, 1884, 1887, 1889, 1897, 1907. Scan the text for what happened on each of the dates; 2. these geographic place names should be marked: Kodiak, Aleutian Islands, Bering Sea, Bering Straits, Arctic Ocean, Okhotsk Sea, Pt. Belcher, Icy Cape, Pt. Barrow, Cape Thompson, MacKenzie Bay and your community; 3. 18; 4. 315; 5. 3,150 gallons; 6a. 12; 6b. 2,000,000 gallons; 7a. trade items, warm clothes, knife, boots, binoculars, journal, pencils, quill pens, ink, oil cloth rain gear, sea bag, books, etc.; 7b. good food, something to keep you from getting scurvy, extra rain gear, knives, extra materials for boat repair including sailcloth, line (rope), tools, nails, whaling gear, etc. Students may be interested in these figures on the Typical Cost of Whaling Voyage.

TYPICAL COST OF WHALING VOYAGE
(including outfitting and original cost of ship)

List of the principal articles required to outfit a vessel for a voyage in sperm whaling, together with the amount of each article and cost according to the prices which prevailed on January 1, 1844.

ARTICLE	AMOUNT		PRICE	COST
Oil Casks	2,800	Bbls.	$ 1.25	$ 3,500.00
Beef & Pork	240	Bbls.	8.50	2,040.00
Flour	220	Bbls.	5.25	1,155.00
Corn	75	Bushels	.55	41.25
Beans & Peas	14	Bushels	1.25	17.50
Corn Meal	5	Bbls.	3.50	17.50
Tobacco	2,500	Lbs.	.11	275.00
Rice	1,200	Lbs.	.035	42.00
Potatoes	150	Bushels	.35	52.50
Cheese	800	Lbs.	.07	56.00
Butter	900	Lbs.	.13	117.00
Dried Apples	600	Lbs.	.04	24.00
Vinegar	10	Bbls.	3.50	35.00
Cod Fish	800	Lbs.	.03	24.00
Molasses	1,600	Gals.	.27	432.00
Tea, Black	250	Lbs.	.35	87.50
Tea, Hyson	20	Lbs.	.60	12.00
Raisins	200	Lbs.	.05	10.00
Sugar	1,000	Lbs.	.075	75.00
Coffee	1,000	Lbs.	.08	80.00
Duck, Heavy	60	Pieces	18.00	1,080.00
Duck, Light	36	Pieces	8.00	288.00
Tar	20	Bbls.	2.25	45.00
Whale Boats	6	Boats	60.00	360.00
Oars	7	Sets	8.50	59.50
Boards	4,000	Feet	20.00M	80.00
Nails, Composition	700	Lbs.	.22	154.00
Copper, Sheathing	8,500	Lbs.	.21	1,785.00
Cordage	8,500	Lbs.	.10	850.00
Tow Lines	3,000	Lbs.	.12	360.00
Try Pots	3	Pots	60.00	180.00
Cloth	6,000	Yards	.09	540.00
Iron, Whaling Crafts	4,000	Lbs.	.15	600.00
Clothing, Ready-Made				2,800.00
Labor in Port				2,500.00
TOTAL COST OF OUTFIT				$19,774.75
COST OF A TYPICAL VESSEL				31,224.72
COMBINED COST OF VESSEL AND OUTFIT				$50,999.47

From: The American Whaleman
by Elmo Paul Hohman

2. Have students try their hands at scrimshaw. Explain that old-time whalers carved beautiful objects in their spare time at sea. The sperm whale tooth ivory was a favorite for carving. The same techniques can be demonstrated on heavy plastic, wood, or soft-fired clay. Bring out the Clorox bottles or pieces of wood. Use heavy-duty scissors to cut the Clorox bottles into manageable pieces. Use knives to carve the wood into interesting shapes. Sand the wood. Have students draw designs on paper first, then etch the outline on the wood, clay, or plastic. Apply a tiny drop of ink. (Ivory India ink.) Rub the ink thoroughly into the cut and wipe it off immediately with a tiny piece of paper towel or a rag moistened with saliva. Then continue to make more cuts, ink, rub, and wipe until the etching is complete. Invite people in your community who scrimshaw or carve ivory to demonstrate their techniques. Also show students ivory from personal collections or from a local gift shop.

3. Sing some sea chanties to get that feeling of what it was like to be on an old whaling ship. The worksheet Blow Ye Winds should get you started. Sea chanties were used for entertainment (no TV on the old ships!) and to make the work go more easily. Pulling sails on those old-time ships was rough work that required lots of muscle power. The chanteyman and fiddle or banjo player was an important part of the crew.

Additional Activities:

1. Language Arts. Read whaling stories or excerpts (Moby Dick) and have the students try writing creative stories with these beginnings:

   We lowered the boats and took out after the largest sperm whale I'd ever seen...

   In the midst of the South China Sea, we came upon a ship under full sail with not a soul aboard....

   The Mate's booming command, "All hands on deck!" sent us tumbling from our bunks, scrambling into our foul weather gear and up the ladder to face the icy breath of Cape Horn....

   The band of burly, raucous sailors burst into the smoke-filled atmosphere of the tavern.

   "You're not going to ship on that ship, are you, mate?" whispered the bearded sailor between his teeth, his weathered hand gripping my arm like a band of iron....

   The ship had been gone three years, and every day now the Captain's wife could be seen on the "widow's walk," her eyes eagerly searching the horizon for an approaching sail....

(Suggestions from the Mystic Seaport Museum, Mystic, Connecticut, where the old whaling ship Charles W. Morgan can still be seen and visited.)

2. Language Arts. Order a copy of the booklet Life on

Board American Clipper Ships by C.R. Schultz from Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, Texas ($1.00). Read parts of this succinct little guide to your students, or challenge some of your better readers with these fascinating stories.

3. Language Arts. Have students try their hand at the worksheet Old-time Whaling Puzzle developed by the Mystic Seaport Museum, Mystic, Connecticut. (Answers: Across 1. scrimshaw; 2, figurehead; 3. blubber; 4. harpoon; 5. mate; 6. whaleboat; 7. flukes; 8. navigate; 9. cooper; 10. lance; 11. aft; 12. watch; 13. hemp; Down 1. spermaceti; 2. forecastle; 3. baleen; 14. line; 15. rigger; 16. deck; 17. apprentice; 18. gear; 19. fathom; 20. bow; 21. helmsman; 22. log; 23. barrel.)

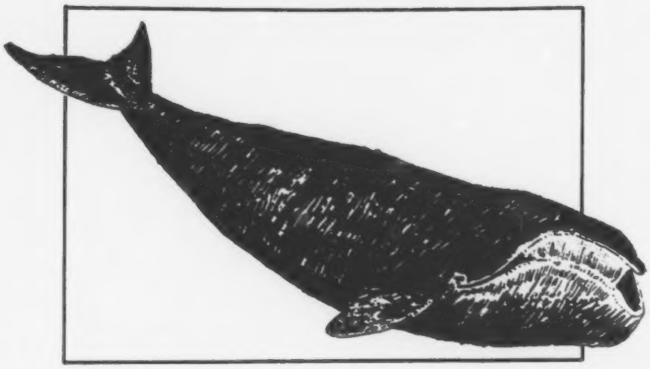
4. Home Economics. Have students make "hard tack," a staple on whaling voyages. Ingredients:

2 c. flour
1 tsp. shortening
½ tsp. salt
½ c. water

Work in shortening, add water, mix. Beat dough with a mallet until ½-inch thick. Fold and repeat several times and then cut up into biscuit size. Bake 30 minutes at 325°. Requires good teeth!

(Suggested by the Gulf of Maine Marine Education Association's Newsletter, Whale Tales, edited by Clay Carkin)

Activity 9
Battle Over the Bowhead



Background:

Every spring, the great bowhead whales begin to make their way up through the Bering Strait to their summer feeding and calving waters in the Arctic Ocean and the Beaufort (BOW-fert) Sea. And the Iñupiat Eskimos will be waiting, as they have for thousands of years.

Long ago, other Native people hunted many kinds of whales that sounded and blew in Alaska waters. With poisoned spearheads and magic charms, the Aleuts matched their fragile one-man skin boats against the awesome size of the gray, fin, sperm and bowhead whales. There were also scattered coastal whaling cultures from Yakutat to Cook Inlet, from Kodiak to the Bering Sea.

In the late 1800s and early 1900s, commercial whalers killed most of the great whales in the world's oceans. As a result, an international treaty was drawn up to try to save the whales that remained.

Among the endangered species is the great bowhead, *Ballena mysticetus* (ba-LEEN-uh miss-ti-SEE-tus). Once, thousands ranged through all the northern seas.

But today, except for isolated groups in northern Canada and eastern Siberia, the only bowheads left are believed to be those who follow the retreating Bering Sea pack ice on their spring migration into the Arctic Ocean. And only the northern Iñupiat Eskimos, the last of Alaska's great whaling cultures, continue the traditional hunt.

In 1977, for the first time in history, the International Whaling Commission extended its control to cover subsistence hunting in an effort to save endangered whales.

Can both the Eskimo's lifestyle and the whales survive? How? What other values are involved? See what your students think after they take part in the following Tidelines TV news special, "Battle Over the Bowhead."

Materials:

- worksheets:
  ...Battle Over the Bowhead (2O)
  ...The Whale's Tail (2P)

Procedure:

1. Ask students to tell what they know about the bowhead whale controversy. Pass out the worksheet Battle Over the Bowhead and explain that this is their chance to do a TV special on the bowhead. Select members of the class for each part and let each one choose a team of advisors. If you can get the equipment, have the class videotape the TV special with some members of the class acting as the camera crew.

2. After the production, explain that it came from the March 1979 Tidelines. How is the situation different now? Your class might want to look for newspaper clippings or contact the National Marine Fisheries Service, Alaska Department of Fish and Game, or Eskimo Whaling Commission. How would your students solve this issue? What are some of the problems of marine mammal management?

3. As a review, pass out the worksheet The Whale's Tail. Here are the answers:

H	U	N	T	■	S	T	O	P
E	S	K	I	■	P	E	R	U
A	S	■	P	O	E	■	A	L
D	R	Y	■	K	R	I	L	L
■	■	E	A	■	M	W	■	■
W	H	A	L	E	■	C	A	W
H	A	■	E	T	A	■	E	E
A	T	T	U	■	L	A	W	S
T	E	N	T	■	P	A	C	T

Unit Three Logging, Fisheries and Wildlife

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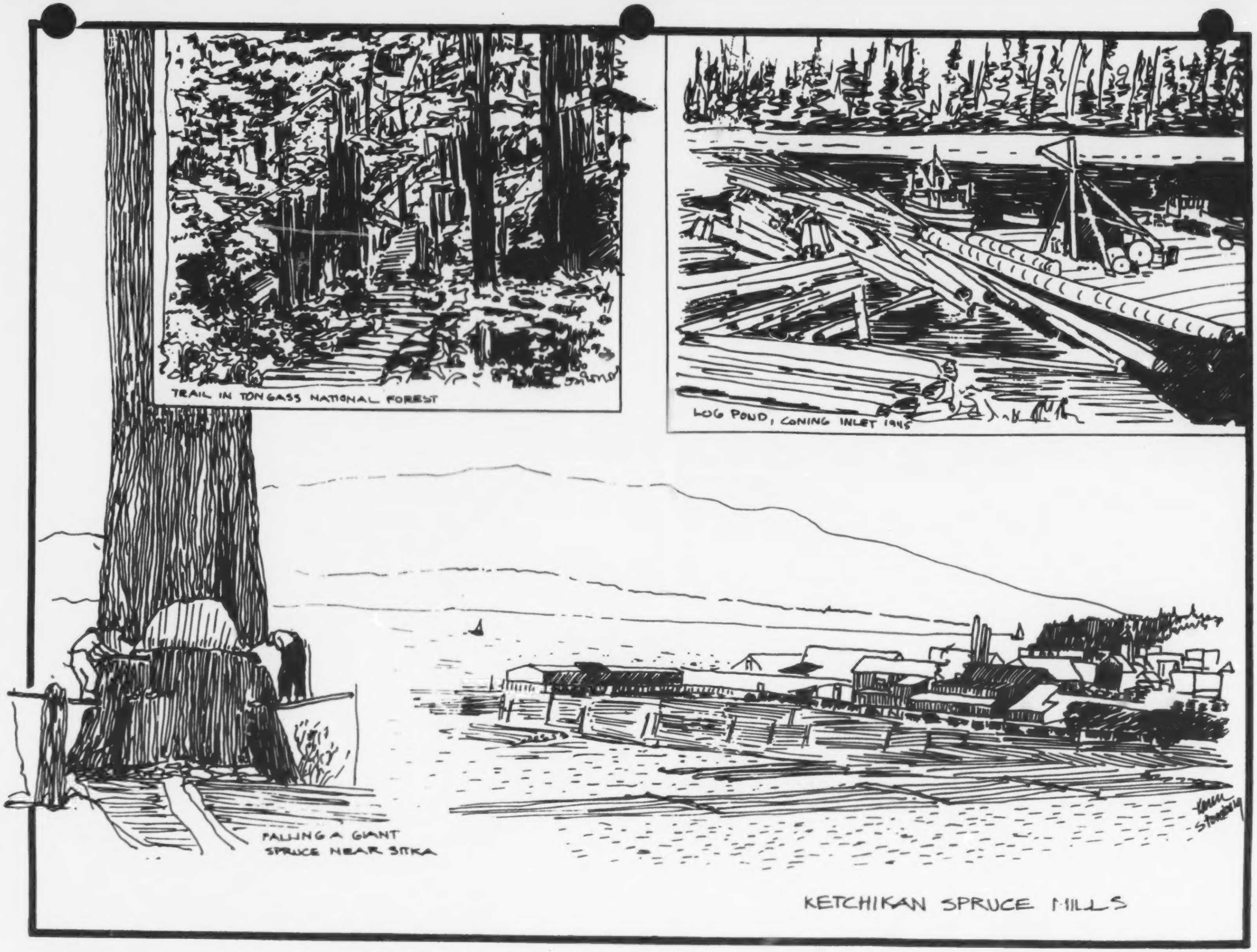
Objectives:

To help students:

- Match pictures of trees and woodland shrubs with their descriptions (Activity 1).
- Inventory their own homes for wood products (Activity 1).
- Practice different harvest methods on a model forest (Activity 1).
- Sequence the growth and use of a tree from seed to wood product (Activity 1).
- Make a classroom mural of fish habitat needs in a stream and estuary (Activity 2).
- Develop a list of rules to protect fish habitat in a timber sale (Activity 2).
- Graph deer use of forests before and after clearcutting (Activity 3).
- Interpret data on bird use of old-growth forests (Activity 4).
- Read about the ways birds use old snags and place the events in a tree's cycle in sequence (Activity 4).
- Investigate and take field notes on fish, wildlife and vegetation on a logged over and old-growth forest (Activity 5).
- Write a poem or draw a picture about the field experiences (Activity 5).
- Describe the economics of logging (Activity 5 and 6).
- Mark local logging areas, proposed timber sales, and spawning streams on a map (Activity 6).
- Debate logging, fisheries and wildlife conflicts (Activity 6).


TRAIL IN TONGASS NATIONAL FOREST
LOG POND, CONING INLET 1945
FALLING A GIANT SPRUCE NEAR SITKA
KETCHIKAN SPRUCE MILLS

UNIT THREE: Logging, Fisheries and Wildlife. Examining the way the timber industry affects Alaska's fisheries and wildlife and learning how to manage these vital renewable resources for the benefit of all three is crucial to understanding modern-day Alaska.

Forests are an integral part of our coastal and river habitat in southeastern, southcentral and Interior Alaska. Forests, fisheries and wildlife are all renewable resources, which means that with wise use, they will supply us with wood products, food, jobs, recreation and enjoyment forever. But as with any resource, harvest and management are both complex and controversial. The fall 1980 issue Alaska Fish Tales and Game Trails, published by the Alaska Department of Fish and Game, does an excellent job of analyzing these topics. (Kay Pearson at White Cliff Elementary in Ketchikan suggested many of the ideas for this unit.)

Activity 1
Logging Practices

Background:

One-third of Alaska is forested. Most of the Interior and southcentral forest is reserved for recreation, hunting, wildlife habitat, watershed protection and subsistence purposes. But much of the forest in Southeast Alaska and on Afognak Island is involved in timber harvesting that produces lumber and wood products for use here and abroad.

Vocabulary:

- renewable resource
- sustained yield
- allowable cut
- clearcutting
- single tree selection
- seed tree selection
- selective cutting
- skidder
- choker
- yarding
- thinning
- deciduous
- coniferous

Materials:

- samples of local tree species (branch tips)
- cake pan or cookie sheet with turned-up edges
- soil
- moss
- sticks or tips of tree branches
- construction paper
- scissors
- small saws or knives
- string
- worksheets:
  - ...Do You Know Your Trees and Shrubs? (3A)
  - ...Wood and Wood Products Inventory (3B)
  - ...Log Those Trees (3C)
  - ...From Seed to Lumber and Pulp (3D)

Procedure:

1. Ask students to name the local trees and shrubs. Put the list on the board. Pass out local tree and shrub samples and the worksheet Do You Know Your Trees and Shrubs? Explain the difference between deciduous (lose their leaves) and coniferous (evergreen) trees. But remember, tamarack is very unusual because it is considered a conifer even though it loses its needles every year. Have students match pictures with descriptions and circle species for which you have samples. Challenge students to find additional local species after school. Try to get a copy of Alaska Trees and Shrubs, by Viereck and Little, as a reference. Sometimes the Forest Service has copies (USFS, P.O. Box 1628, Juneau, Alaska 99802). Two versions of the book are in print: a condensed paperback for use in the field, and a hardback edition. (Worksheet answers: 1. willow; 2. western hemlock; 3. lodgepole pine; 4. tamarack; 5. Alaska cedar; 6. alder; 7. paper birch; 8. poplar or cottonwood; 9. quaking aspen; 10. black spruce; 11. white spruce; 12. Sitka spruce; 13. common juniper)

2. For homework, give students the worksheet Wood and Wood Products Inventory to report back on wood products that they use. Compile the results into a class list.

3. Have students relate their logging experiences. Explain that the class will be making a model forest to demonstrate logging techniques. Have students place soil in a cake pan or cookie sheet and add moss on top. Then add sticks or branch tips to make a "forest." Make a stream out of blue construction paper.

4. Use the worksheet Log Those Trees to introduce methods that the class can use to harvest their "forest." Go over the terms mentioned on the worksheet. (Answers: 1. seed tree selection, seed, seed; 2. clearcutting, cleared, cleared; 3. single tree selection; 4. 1, 3, only selected trees are cut; 5. cutting trees adjacent to the best trees so that the best trees will have more room to grow; 6. they can be continually replenished by growing up again from seeds; 8. circle the trees along the stream)

5. Have the class select one of

the three logging methods to demonstrate on their model forest. They will need knives or small handsaws to cut down the trees in lieu of power chain saws. The branches should be trimmed and the tops cut off. Then they can attach choker chains (string) and drag the logs either down to tidewater or up to a road for yarding (an area where the logs can be stacked). Loggers use a skidder (which looks something like a bulldozer) to drag several logs at once. Discuss the potential to cause soil erosion as the moss and topsoil is torn up by the skidding operation. Be sure to leave some trees along the stream, and don't do any skidding across the stream--to reduce erosion and protect the fish in the stream. (See the next activity for more explanation.) On very steep slopes, loggers will sometimes use balloons or helicopters to help with the harvest, so that skidders do not constantly run up and down the slope, causing soil erosion that is usually irreparable.

6. So now the class either has the logs to tidewater or lying beside a logging road. What happens next? Use the worksheet From Seed to Lumber and Pulp to discuss the lumbering process. (Answers: Tree seeds, tree seedling, full-grown tree, timber, trim branches and top, attach choker chain, skidder hauls to road or tidewater, logging truck or log boom, lumber and pulp mill, lumber, off to Japan, scrap lumber, paper mill, pulp, stores, your house, your summer job planting trees--these last, from lumber on, are quite variable!)

Additional Activities:

1. Science, Art. Have students make a leaf/needle collection of the local tree and shrub species, complete with drawings of the full-size trees and identifying marks. Students can add forest plants to their inventory, too. Use Hulten's Flora of Alaska for identification, or Viereck and Little's Alaska Trees and Shrubs.

2. Math. Have students figure how many trees were used to make all the wood and wood products in their homes. Obtain information on the number of board feet in an average tree from a local forester. (A board foot is 1' x 1' x 1".) If students burn firewood, have them figure the number of trees required to heat their house every year. (One cord equals a 4' x 4' x 8' stack of wood.)

3. History, Social Studies. Read portions of Handloggers by W.H. Jackson and discuss old-time logging practices. Invite a logger or forester to come to your class and discuss present-day logging methods, and to answer your questions about logging practices in your area.

4. Science. Take a beach or riverbank walk, trying to identify species of driftwood and guess where it originated. Driftwood along the northern Alaska coast generally comes from the Mackenzie River Delta. Western Alaska's driftwood comes from the Yukon River.

Activity 2
Fish Streams and Timber Sales

Background:

Proper use of Alaska's timber and fisheries, both renewable resources if used wisely, is a question fraught with controversy, especially in Southeast Alaska. Fisheries biologists believe that the two major factors that have reduced Southeast salmonid stocks are overfishing and loss of habitat.

"Though overfishing is a complex management problem, it is compounded by the loss of habitat, which either delays or prevents the recovery of individual salmonid populations. At present, timber harvest and associated activities are the primary commercial uses of forest lands in Southeast Alaska, and consequently, have the greatest potential for altering habitat."

--from "Chain Logs, Food Chains and Fish Streams" by Elliott, Koski and Meehan in Alaskan Fish Tales and Game Trails, Fall 1980

Information for this activity was adapted from the above-mentioned article and the Forest Service pamphlet, Logging and Fish Habitat.

Vocabulary:

- pool
- riffle
- sedimentation
- turbidity
- nutrients
- microorganisms
- microbes
- debris
- estuary

Materials:

- large sheet of butcher paper or chalkboard
- felt-tip markers or chalk
- worksheet:
  ...As a Fisheries Biologist (3E)

1. Make a classroom mural (see illustration) of a stream and downstream estuary on either a large sheet of butcher paper or on the blackboard--as the basis for discussion of fish habitat needs. Review the meaning of estuary (a highly productive wetland where fresh and salt water mix as a river or stream meets the sea. For more information on wetlands and fisheries, check Alaska Sea Week Curriculum Series, volumes V and VI). Ask students:

   - What are the three basic requirements of all fish? (Food, cover and water quality, including temperature, oxygen and nutrients in both the stream and downstream estuary. Cover for fish includes instream and overhanging logs that can be used for hiding from predators, as well as shrubs and trees that provide shadows for hiding. Add this information to your drawing.)

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- What do the fish in the stream eat? (Insects, both land and aquatic varieties. Add these to your drawing. Some types of insects live in pools and others live in riffles.)

- What do the insects eat? (The microorganisms on needles, twigs, and leaves that fall into the stream or are adjacent to the stream. The microorganisms on this dead vegetation are like "peanut butter on a cracker" for the insects; i.e., the microbes supply the protein and nutrients for the insects.)

- Where does this instream vegetation that the microbes like so much come from? (From shrubs and trees along the stream.)

- Why else are trees and shrubs along the stream important? [They provide cover (protection from enemies) in their shadows and shade, so that the stream temperature remains cool in the summer. And trees help to insulate the stream in the winter, preventing freeze-up. Dead trees that fall into the stream or across streams also provide cover and shade, as well as sometimes helping to form pools, which are good places for fish to rest.]

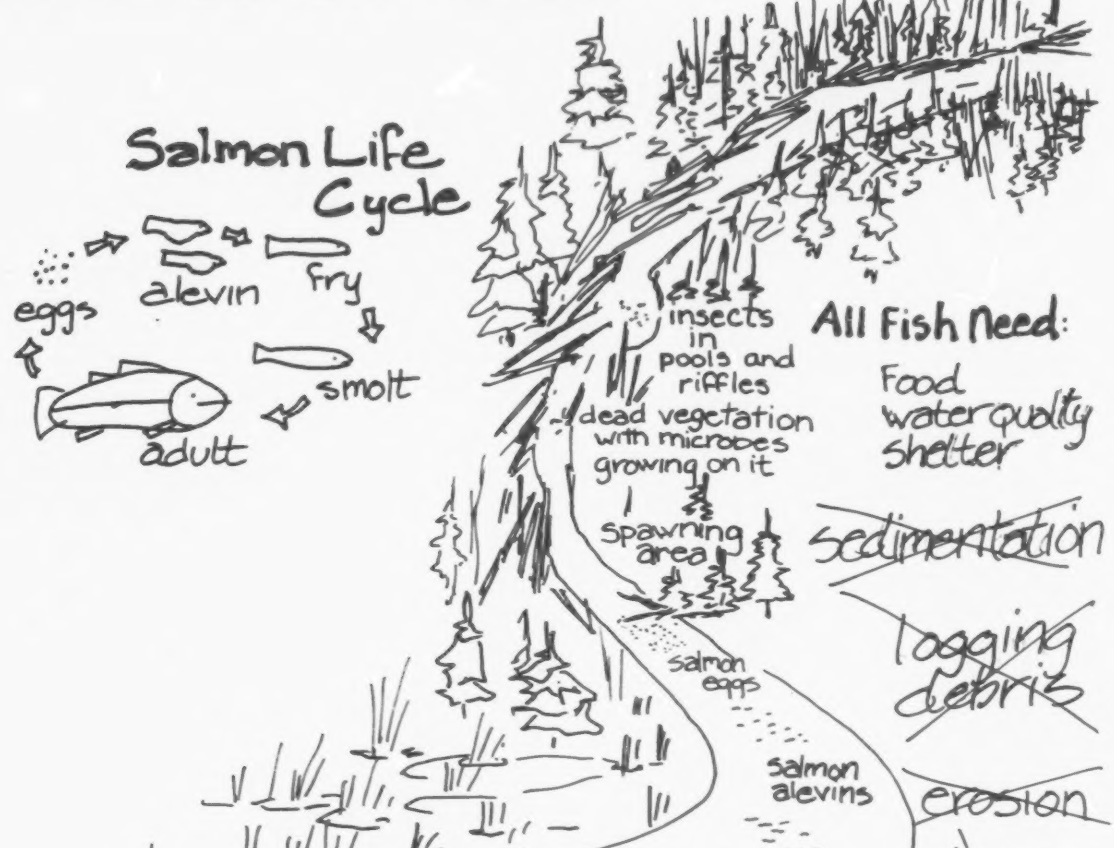
- How do salmon use the stream? (They need clean gravels, oxygen, and cool temperatures for spawning and for rearing their young. Pink and chum smolt migrate to both estuaries and the sea during their first spring, but king, coho, and sockeye salmon, rainbow and cutthroat trout, and sea-run Dolly Varden char spend one to two years in streams and lakes before heading to the sea.)

- Where do nutrients come from and where do they go? (Many nutrients come from streamside vegetation, which decays and falls in the water where it is fed on by insects. Nutrients also come from the bodies of spawned-out salmon. A few minerals and nutrients come from rocks and soil. All the leftover nutrients go downstream to the estuary, where they feed zooplankton, which in turn feed many varieties of coastal fish and shellfish.)

- How does the stream maintain high oxygen levels? (By staying cool, for cool water holds more oxygen; by having riffles, which mix oxygen with stream water; and by remaining unpolluted. For example, if too much organic material, such as logging debris, remains in a stream, the animals helping it decay increase in numbers. Since these all require oxygen, an oxygen deficit is created.)

- What does increased sediment mean to the fish in a stream? (It causes fish eggs to be covered up so they don't get any oxygen and they die. It causes the instream vegetation to be covered up so microbes and insects don't have a place to feed. And with increased turbidity (sediment in the water), fish have trouble seeing their food. Sediment also fills in the pools, reducing the number of resting places.)

Fish Habitat Needs


Salmon Life Cycle
eggs
alevin
fry
smolt
adult
insects in pools and riffles
dead vegetation with microbes growing on it
spawning area
salmon eggs
salmon alevins
salmon fry
salmon smolt
salmon smolts
ESTUARY
All Fish Need:
Food
water quality
shelter
~~sedimentation~~
~~logging debris~~
~~erosion~~
~~tree bark~~

- How does sediment get into a stream as a result of logging? (From erosion caused by the loss of the trees, shrubs and ground cover that hold the soil in place. Roads, skidding logs, logging on steep slopes and not leaving a streamside barrier to help hold the soil all contribute to increased erosion and the resulting sedimentation of the stream.)
- What is the effect of log dumping, storage and erosion on estuaries? (Increased sediments cover up bottom-dwelling organisms and reduce light levels in the water, so less plankton can grow, which in turn means less food for fish. Studies have shown that crab reproduction is reduced in areas where bark covers the sea floor. Also, some of the natural chemicals found in tree bark are toxic to young shrimp, Dungeness crab and pink salmon.)

For further information, consult "Chain Logs, Food Chains, and Fish Streams" by Elliot, Koski, and Meehan in Alaska Fish Tales and Game Trails, Fall 1980.

2. Pass out the worksheet As a Fisheries Biologist, and have students come up with a list of rules for logging to protect fish habitat. Answers are adapted from the Logging and Fish Habitat pamphlet produced by the U.S. Forest Service. They don't need to be in this order but should include:
    1. Fall and yard timber away from streams when logging close to streambanks.
    2. Leave a fringe of windfirm timber along streams for stream protection.
    3. Keep debris out of streams. If some does get into streams, remove it immediately.
    4. Avoid skidding logs in or across streambeds.
    5. Do not run equipment in the streams.
    6. Use proper stream-crossing bridges for equipment. Orient road-stream crossing at right angles to minimize erosion possibilities.
    7. Do not yard across or out of V-notches if logs cannot be fully suspended above ground.
    8. Properly engineer road grades, alignment, cut-slopes, waste areas, and culvert and cross-ditch locations. Install and maintain culverts properly.
    9. Restore the original level of the streambed when removing all temporary culverts.
    10. Revegetate any disturbed soil.
    11. Avoid logging altogether on extremely steep slopes (helicopter and balloon logging can be used on moderately steep slopes).

Activity 3
The Deer and Logging Dilemma

Background:

In the Lower 48, biologists have been claiming that clearcutting improves habitat for deer. But in Alaska, joint studies by the Alaska Department of Fish and Game and the U.S. Forest Service show that clearcutting drastically reduces deer use.

The problem is twofold: 1) Clearcuts (0-25 years) have ample deer forage, but they fill with snow in winter and are thus unusable; 2) second growth (25-150 years) with its even-age growth doesn't allow light on the forest floor, so deer forage can't grow. In contrast, old-growth (climax) forests (200 years) are composed of trees of different ages and sizes. The upper limbs intercept the snow, and yet there are enough holes in the forest canopy so that light can get through to grow ample deer forage.

As a result of this research, biologists in the Lower 48 are reanalyzing their data. It appears that they were actually looking at second growth, even-age forests when they were saying "old growth" was poor deer habitat. According to accounts of early descriptions of virgin forests on the North American continent, deer were abundant. Much of the timber harvest in Alaska, particularly in Southeast, is in this old-growth forest. If recutting continually occurs at 100 years as is proposed, this old-growth habitat will be lost for deer as well as for other animals.

(Additional background information can be found in two articles in Alaska Fish Tales and Game Trails, "Deer Logging Relationships in Southeast Alaska" by Schoen and Wallmo, July/August 1978, and "Deer, Forestry, Logging Habitat" by Lentfer, Schoen, Matthews and Kirchhoff, Fall 1980. Additionally, in the Alaska Department of Fish and Game's Wildlife Information Leaflet #5, Sept. 1978, "Deer and Logging: A Clearcut Dilemma.")

Vocabulary:

- succession
- climax forest
- old-growth forest
- rotation
- stand
- pellet-groups
- diversity
- canopy
- understory

Materials:

- worksheet:
  ...Graphing Deer Use of Clearcuts (3F)

Procedure:

1. Introduce or review the term "succession." (All plant communities are constantly grow-

ing and changing until they reach their climax stage of vegetation. After a burn or as a glacier recedes and leaves bare ground, some species of plants begin to grow. These plants add enough organic matter to the soil so that other species of plants can grow. Then shrubs take over, and eventually trees dominate. Explain that biologists have become concerned about deer use of clearcuts. Ask students:

- How would you go about figuring out how many deer are in a certain area? (Take aerial counts, though this might be hard in thickly forested areas. Check hunting success records, though this might depend on weather and numbers of hunters. Count the number of pellet groups (piles of fecal pellets) left by deer. The latter is what biologists did in Southeast Alaska. They set up 1x10-meter belt plots across the stand of timber and counted the pellet groups within each plot.)

2. Distribute the worksheet Graphing Deer Use of Clearcuts. These figures are from "Response of Deer to Secondary Forest Sucession in Southeast Alaska" by Wallmo and Schoen in Forest Science, Vol. 26, No. 3, 1980, pp. 448-462. Explain that the figures would be similar for forests in Prince William Sound and on Afognak Island.

(Answers: 1. (illus.); 2a. 300 year uneven-aged stand; 2b. 300 year uneven aged stand; 3a. 3; 3b. 0; 3c. 2; 3d. .1667; 3e. 1667; 4a. 99; 4b. 499: 4c. 169; 4d. 1206; 4e. (illus.); 4f. (illus.); 5. 250-300 years; 6. populations will decline)

Additional Activities:

1. Science, Social Studies. Invite a wildlife biologist to speak and show slides to your class about deer and other wildlife uses of old-growth forests. Bald eagles, mountain goats, moose, marten, brown bear, Canada geese and a number of other birds also use old-growth forests. Begin thinking about jobs in the timber industry versus wildlife values (See Activity 6 in this unit).

2. Math. Obtain figures from the U.S. Forest Service on the current Tongass National Forest acreage, its yearly allowable cut, and the acreage that is classified as old-growth. Then figure the current percentage of old-growth forest and the percentage that will remain in 10,20, 30,40,50 and 100 years. The high volume old-growth timber, which occupies a small proportion of the total forest, is usually the best winter deer habitat. However, it is also the preferred type of logging area, and is cut in much higher proportion than it occurs.

Activity 4
Bird Use of Old-Growth Forests

Background:

In recent years, interest has grown all over the country in non-game wildlife species. Bird-watching, for example, has become a multi-million dollar business, with people buying bird books, binoculars, cameras, outdoor clothing and other equipment, as well as driving and flying endless miles in pursuit of elusive birds. The Alaska Department of Fish and Game now has a non-game program, and other agencies are also funding research and educational programs. Hunters and non-hunters alike enjoy bird songs and sightings. Non-game birds and other wildlife are an important part of our total environment.

Vocabulary

- non-game
- cavity nesters
- snag
- riparian
- edge effect

Materials:

- pencils
- glue
- paper
- bird field guides
- worksheets:
  - ...Birds in the Old-Growth Forest (3G)
  - ...Save that Snag! (3H)

Procedure:

1. Introduce the concept of non-game wildlife species. Distribute the worksheet Birds in the Old-Growth Forest. (Answers: 1. Greater: orange-crowned warbler, dark-eyed junco, Steller's jay, fox sparrow; Smaller: chestnut-backed chickadee, golden-crowned kinglet, western flycatcher, hermit thrush, varied thrush 2. winter wren; orange-crowned warbler; golden-crowned kinglet 3. Townsend's warbler, golden-crowned kinglet 4. midsuccessional 5. not necessarily. This study was only done once in one specific area. A study done on another forest with a different terrain and climate and different types of trees and shrubs would show different results. (Studies in some areas have shown greatest diversity in old-growth forest and in others, like this one, in a particular stage.) 6. There might be fewer kinds of birds because there is less variety of plants for them to eat or nest in. 7. (illus.); 8. in tree cavities; 9a. streamside; 9b. drawing should show trees left along stream and several small clearcuts to maximize the "edge" effect)

2. Pass out the worksheet *Save that Snag!* Students will need scissors, glue and another sheet of paper. This activity was adapted from information in "New Life from Dead Trees" by R.M. DeGraaf in *National Wildlife*. (Answers: 1. D; 9. I; 3. F; 5. B; 6. H; 4. A; 8. E; 2. G; 7. C)

3. Discuss the idea that some bird species have become extinct because of habitat loss. For example, the American ivory-billed woodpecker is probably extinct because it needed old-growth forests to survive. The passenger pigeon is another bird that became extinct--partly due to loss of its old-growth forest habitat, partly from overhunting. R.M. DeGraaf notes, in the article mentioned earlier, that 85 of the 800 U.S. bird species are cavity nesters. These birds play an important role in the forest as pest-control agents. Most are insect eaters.

Activity 5
Logging Field Trip

Throughout this unit, students have been learning about different aspects of logging and its effects on fish and wildlife. A well-planned field trip can strengthen what they've been learning and give them a chance to see logging in action.

Materials:

- paper
- pencils
- tree borer
- logging operation or logged-over area
- lined paper
- measuring tape
- small plastic bags
- string
- field guides to trees, birds, animal tracks, insects
- thermometers
- old-growth forest
- resource people - logger, forester, fisheries and/or wildlife biologist
- Fish Habitat Guidelines (from Activity 2) for each student
- worksheet:
  ...*Comparing Stumps and Trees* (31)

Procedure:

1. Arrange for students to visit a logging operation and an old-growth forest. Plan to talk to one of the loggers on site. Invite a forester, wildlife and/or fisheries biologist to go with the class.

2. Have the class make field notebooks by cutting lined paper in fourths and stapling it together. Attach a pencil with a string and place in small plastic bags in case of rain. Discuss with students the importance of taking accurate notes on what they see. If they do not know what something is, have them draw pictures. Tell them that after the field trip, they will be comparing the logged-over area to the old-growth forest; so to take good notes and be sure to write down the date, time and location.

3. Have a logger at the logging operation explain what's happening. Ask the logger about the economics of logging and about the dangers of being a logger. What safety practices do they use?

   Look at a stream within the logged area. Watch for signs of erosion and/or sedimentation. Does this logging operation follow the fish habitat guidelines your class developed in Activity 2? Have students check each one. Then look for fish in the stream.

   Find a stump and figure out the age of the tree. Measure its diameter and height above the ground. Check for signs of decay. Squeeze a little bit of rotten wood on the stump or from an older log on the ground and see how much water it holds.

   Listen and watch for birds. Your class might want to try setting up a bird transect. Measure off 100 meters and stop every 20 meters and listen and watch for birds, as described in worksheet 3G.

   Look for animal signs such as deer pellets. If the clearcut is new, try to figure out whether they were dropped before or after it was made. Count the number of pellet groups in 1x10-meter plots, as in Activity 3.

   Watch for tracks, too. Measure the distances between tracks and note the shape and pattern.

   Measure and record the soil temperature, air temperature and water temperature at different points in the logged and unlogged portions of the forest.

   Investigate a square foot of soil. See what insects students find, and then be sure they replace the soil just as they found it.

   Have students identify trees and other plants. Estimate tree heights. One quick way is to have a person of known height stand next to the tree. Stand a distance away and hold a pencil or short stick at arm's length. Sight across the top of the stick to the student's head. Slide your thumb up or down on the stick until you sight on the top of the thumb to his feet. Keep your thumb at this position. Then begin raising the stick up the tree and count the number of "person heights" it takes to reach the top. The height of the tree is this number times the height of the person. Many other ways to compute tree heights and to take other tree measurements are included in Outdoor Activities for Environmental Studies by Clifford E. Knapp (see bibliography).

If foresters are handy, have them show you how to "cruise" timber (measure the trees to find out how much lumber the company can expect to harvest from the sale). Melissa Hadley's Measuring the Forest explains this process in detail.

Also, take some quiet time to just listen, draw a picture, or write a poem, especially if it is a nice day.

4. Go to the old-growth forest and do similar studies. Here you may have to use a tree borer to estimate tree age, though the trees may be so big it would be of little use!

5. If you have time, also stop at an area that was clearcut quite awhile ago. It's important to see these older (40-100 years) second-growth stands. These are where the problems are for foraging deer in particular.

6. Back in the classroom, have students transcribe their notes onto the worksheet Comparing Stumps and Trees. Compile the class data on the board. Discuss difficulties encountered in taking field notes. Then have students write up the results of their field investigations.

Additional Activities:

1. Art, Science. Make dioramas of the logging operation and logged over and old-growth forest.

2. Social Studies, Art. Visit a logging mill. Ask questions about economics, jobs, safety, sustained yield, allowable cut, silviculture (tree farming) and environmental protection. Afterwards, have students diagram the route a log takes as it goes through the mill, and what happens afterwards.

Activity 6
Logging, Fisheries and Wildlife Debate

Background:

In this unit, the class has been gathering information on wildlife, fisheries and logging concerns. This activity gives students a chance to pull all this information together both for an in-depth analysis of the issues and for practice with critical thinking skills. Perhaps these same students will contribute to solutions.

A key to resource-issue solutions are the agencies responsible for management. The U.S. Forest Service is a multiple-use agency. Their lands can be used for timber harvesting, mining, hunting, fishing, wildlife viewing and recreation, though not all at the same time! The Bureau of Land Management (BLM) has similar responsibilities for the interior lands of Alaska. The National Park Service manages its lands primarily for wildlife viewing, natural history interpretation, and recreation. Sport hunting is allowed in preserves managed by the Park Service. but not in parks, where only subsistence hunting is allowed.

The U.S. Fish and Wildlife Service manages national wildlife refuges. Their prime interest is fish and wildlife habitat protection. Mining and oil drilling are sometimes allowed, as on the Kenai Moose Range, but fish and wildlife protection comes first. The U.S. Fish and Wildlife Service manages migratory birds such as geese and ducks, and also sets hunting seasons and bag limits.

The Alaska Department of Fish and Game manages all other fish and wildlife. The boards of Fish and Game set the regulations, and the department carries them out. Fish and Game personnel research and study various wildlife species and habitats, and also make recommendations to the Fish and Game boards. Fish and wildlife protection officers in the Alaska Department of Public Safety arrests people who don't obey the regulations, and they also follow cases into the courtroom.

The National Marine Fisheries Service handles fisheries management concerns that are farther than three miles from the coast. Offshore regulations are suggested by the International Halibut Commission and the North Pacific Fisheries Management Council. State forestry concerns are handled by the Division of Forestry within the Alaska Natural Resources Department. Native corporations now figure prominently in resource decisions because of their considerable land holdings and capital, received in the Alaska Native Claims Settlement Act of 1971.

Materials:

- felt-tip markers
- local area maps
- fisheries and wildlife biologists
- logging industry representatives
- agency and Native corporation representatives

Procedure:

1. Have students contact state and federal agencies and Native corporation representatives to find out local land ownership patterns, as well as past and future plans for timber sales and logging operations. Color-code and put this information on local area maps. Then talk to the Alaska Department of Fish and Game and knowledgeable local residents about where spawning streams and important deer, bird and other wildlife habitat are located. Mark this information on the map in another color.

2. Discuss the role of each agency in resource management.

3. Invite fisheries and wildlife biologists and representatives of fishing organizations, logging companies, the U.S. Forest Service and the local Native corporation to have a panel discussion or debate. Sometimes, because of scheduling difficulties or reluctance of people to meet with those holding opposing viewpoints, your class might have one person visit one day, and another the next. Sometimes it is more exciting to have just two people debating, but other times a panel is more interesting. Students should prepare questions ahead of time and write down additional ones during the presentations. Remind them to listen carefully to the different viewpoints.

4. Afterwards, have students hold their own debate. This can be done even if you are unable to get speakers. Assign students to research different points of view. Just for fun, you might want to have students switch and defend a different point of view. Or students might submit written summaries of the different viewpoints. Discuss the complexity of issues. Sometimes compromises work and other times people just have to decide whether they want fish to eat or lumber for a new house. Can your students propose solutions? Discuss who would be the best people to implement their suggestions. Have students write or talk to them about their ideas.

Unit Four
Oil and Oil Development

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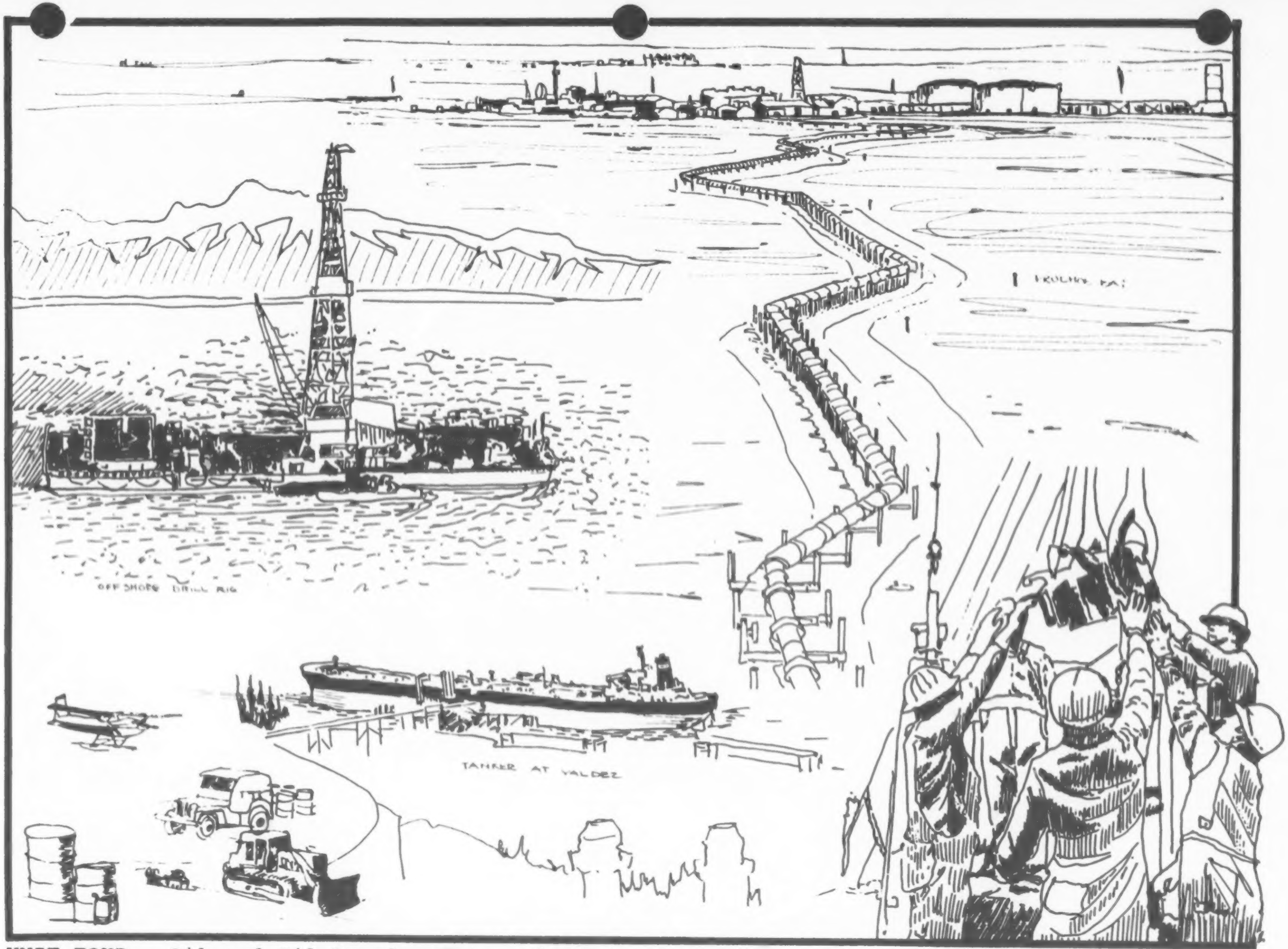
  Worksheets:
    Above and Below the Sea Floor 4H
    Oil in Troubled Waters 4I
    Riches and Risks 4J

Objectives:

To help students:

- Read about how oil originates and where it goes (Activity 1).
- Make an Alaska Oil Timeline (Activity 1).
- Inventory oil and oil products used at home and at school (Activity 2).
- Photograph oil uses and misuses around the community (Activity 2).
- Design and implement an education program on oil uses and conservation (Activity 2).
- Construct a graph to show sources of ocean oil pollution (Activity 3).
- Read about effects of oil spills on fish and wildlife (Activity 3).
- Practice cleaning up an oil spill (Activity 3).
- Figure the mathematics of the offshore leasing schedule (Activity 4).
- Produce an imaginary TV special about the effects of offshore drilling (Activity 4).


OFFSHORE DRILL RIG
PRUDHOE BAY
TANKER AT VALDEZ

UNIT FOUR: Oil and Oil Development. Clockwise from upper left are an offshore drill rig on the North Slope, the pipeline and camp complex at Prudhoe Bay, roughnecks working at a wellhead, and a tanker at Valdez--four pictures of the oil industry, which has had such enormous impacts, for better and for worse, on Alaska's landscape, economy and population.

With the push for energy independence, oil and gas development in the nation's offshore waters has accelerated. Alaska is at the center of the controversy, with as much coastline as the entire rest of the United States, and a huge chunk of the outer continental shelf where most of the oil is located.

Activity 1
Finding That Oil

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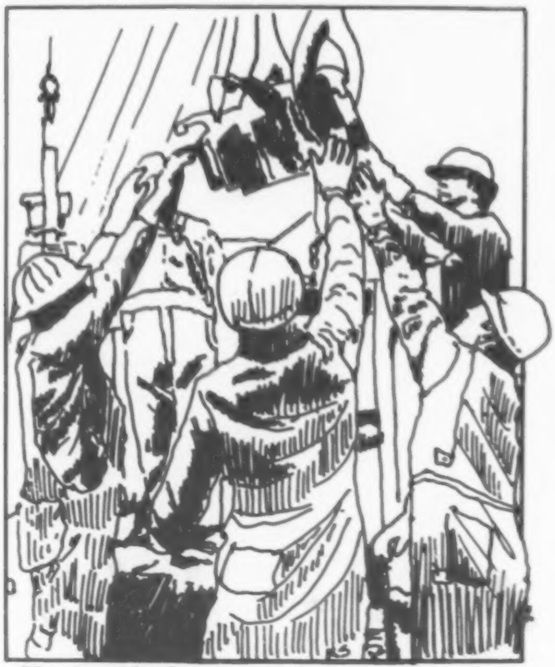


Most Alaskans welcome the jobs and money our oil brings in. And considering the nation's pressing need for energy, there's probably no way we could stop oil development even if we wanted to. But at the same time there is a nagging worry over what might happen in the process, and whether our wilderness and wildlife and special lifestyle will still be around when the oil runs out.

So the trick is to be sure that the things that make Alaska such a good place to live are preserved. And that if changes are made, they are changes for the better. Can we do this? How?

WHAT WE GET

1. MONEY!! Billions and billions of dollars in taxes and a share of the wealth--$3.6 billion in 1981 alone. That's enough to pay most of the cost of state government; build schools, roads, power projects and such; provide low-cost loans for houses, boats, businesses and college educations, and still put money away for the future. (All this with no state income taxes from us.)

2. Jobs--not just with the oil companies, but all kinds of spin-off and support jobs made possible by those oil dollars. State officials say that at least one-third of the work force in Alaska today is dependent upon the oil industry.

WHAT WE GIVE

1. OIL!! Billions and billions of barrels of it. Alaska supplies the United States with about 18 percent of the oil it uses each day. And that's only the beginning. We still have about 30 percent of the nation's proven oil supply that hasn't been touched, and perhaps 50 percent of its oil reserves still to be found. (But once our oil is gone, it's gone forever.)

2. The very big risk that oil spills and industrial activity might damage Alaska's fisheries, wildlife and marine mammals, and our unspoiled waters and wilderness areas--and with this, even our way of life.

The above article is excerpted and adapted from Alaska Tidelines (see credit at beginning).

Vocabulary:

- pterodactyl
- nonrenewable
- petroleum
- resevoir
- shale
- porous
- sedimentary
- seismograph
- casing
- refinery
- royalty

Materials:

- pencil
- paper
- scissors
- glue or tape
- ruler
- worksheets:
  - ...From Pterodactyls to Petroleum: Predictions (4A)
  - ...Where Does the Oil Go? (4B)
  - ...The Alaska Oil Timeline (4C)
  - ...Alaskan Oil Finance (4D)
  - ...Petro Puzzler (4E)

Procedure:

1. Ask students what the effect of oil's discovery in Alaska has had both on the local community and on the rest of the state. Mention what we get and what we give. How has the oil affected every student in the class?

2. Distribute the worksheet From Pterodactyls to Petroleum: Predictions. (Answers: 1. true; 2. true; 3. false; 4.

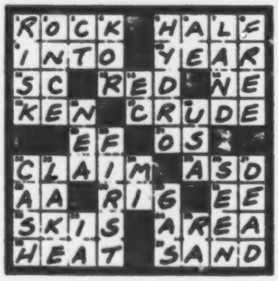
true; 5. false; 6. true; 7. false; 8. true; 9. false.) Remind students that oil originates primarily from decayed plants, as well as from animals such as pterodactyl. Mention that oil is a nonrenewable resource--once used up, it's gone forever, or at least until more plants and animals decay. And each quart of oil took thousands and thousands of years to form. It really is black gold!

3. Distribute the worksheet Where Does the Oil Go? (Answers: 1. pumped back into the ground; 2. piped to Anchorage and nearby communities for fuel; 3. down the pipeline to Valdez and onto tankers for shipment outside; 4. to refineries on the Kenai Peninsula; 5. chemicals made from oil and gas; 6. hydrogen and carbon; 7a. fuel gas; 7b. gasoline; 7c. jet fuel; 7d. heating oil; 7e. lubricating oil; 8a. gasoline; 8b. lubricating oil; 8c. jet fuel.)

4. For the next worksheet, The Alaska Oil Timeline, students will need rulers, scissors, paper, and glue or tape. After they have set the events in proper order, have them research recent developments and write a paragraph together to add to the right end of the timeline.

5. Hand out the worksheet Alaskan Oil Finance. (Answers: Where it comes from; 1. 90 percent; 2. $400 million, $3.6 billion; Where it Goes: 1. $320 million; 2. 26 percent; 3a. education and general government; 3b. natural resource management)

6. Finally, try the Petro Puzzler! (Solution below:)



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■	■	E	F	■	O	S	■	■
C	L	A	I	M	■	A	S	O
A	A	■	R	I	G	■	E	E
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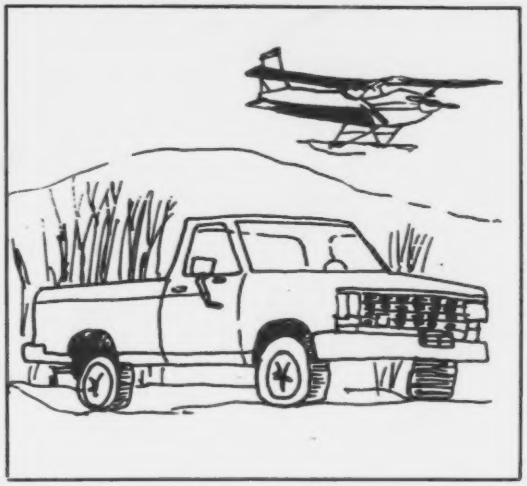
Activity 2
Oil in Your Community



Background:

Oil and its products are an integral part of our society, from transportation to plastics. Alaska is at the "end of the road." Little recycling occurs here, and as a result, our dumps are filled with used oil products--many that are harmful to the environment.

Materials:

- paper
- pencils
- camera and film
- magazines
- scissors
- felt-tip markers

Procedure:

1. Discuss the role of oil in your community. Ask students:

   - How many products do we use in school that are made from oil? (List plastics, styrofoam, movie films, records, tapes, synthetic fabrics, as well as gas and oil.)

   Assign the class to inventory their homes for products made from oil and to research the current prices of gasoline, jet fuel, kerosene, heating oil, lubricating oil, propane.

2. Pass out magazines. Have students cut out pictures of oil products for a bulletin board. Use felt-tip markers for picture captions.

3. Have students make a class list of all the oil and oil-product messes around your community, such as old oil drums, oil storage tanks, oil pipelines, gasoline and kerosene spills at the gas pumps, discarded oil from boat motors, crankcase oil from vehicles, and oil dumped by boats or ships.

   Discuss ways oil and oil products could be reused or disposed of properly. Add this information to your bulletin board. Do not forget that plastics can also be a danger to animals that eat them. Sometimes they choke on them or retain the stuff in their stomachs permanently, taking up room that is better used for food.

   A high percentage of Alaska seabirds have been found with plastics in their stomachs. Those that eat fish eggs are particularly susceptible, as they evidently mistake as food the round particles that styrofoam breaks down into. Other birds and wildlife end up with plastics (such as the filament fish nets) wrapped around their necks, cutting off their ability to breathe, eat and flee from predators.

4. Take a field trip around your community to look for oil products and messes. Take notes and photograph your findings. Even the simplest camera will work for this exercise. Make sure students get close enough to their target and hold their breath, letting it out slowly as they snap the picture. Use prints to make posters, or shoot slides for a slide show.

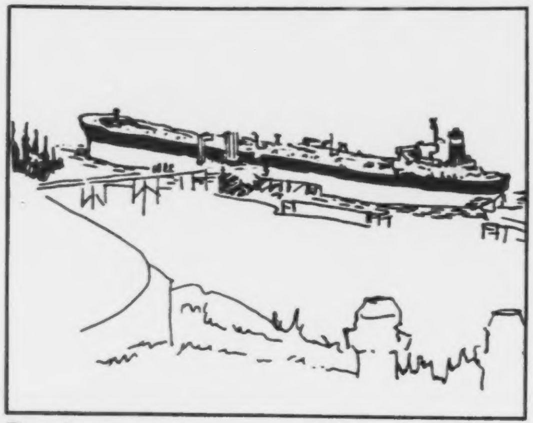
5. What can your class do to help? Remember, oil is a nonrenewable resource. Once used up, we will not have any more. Discuss conservation. Ask the class for suggestions like the following:

   Reuse plastic bags; use cups that can be washed rather than styrofoam cups; be careful not to spill oil; reuse old oil for wood stove fire starter (mixed with sawdust but be very careful) or for oiling tools and shotguns; limit boat or car or snow-go trips to only necessary ones.

   Note that many communities have specific oil-dump sites where oil is placed in storage tanks and stored for later use. Sometimes leftover oil can be used for heating fuel.

   Perhaps your class can plan an education program on local oil uses and misuses. Make up cartoons and posters or a slide show and present your findings and suggestions to other classes and the community.

Activity 3
Oil Spill



Background:

With increasing oil shortages and heightened environmental awareness, tremendous efforts are being made to prevent oil spills. Yet they still occur. In 1975, the U.S. National Academy of Sciences estimated that 6,100,000 metric tons of petroleum products enter the oceans each year. More recent estimates are still close to this amount. A major oil spill can take a devastating toll on wildlife. Sea birds are attracted to oil slicks and will try to dive and feed in them, hopelessly oiling their feathers. When oil gets in the fur of seals, sea lions and sea otters, it means a loss of insulation. In the great baleen whales, oil clogs the hairs that filter plankton out of the water, thus impairing their feeding. Eggs and young of many species of fish and shellfish are harmed by extremely small concentrations of oil (as low as 1 to 10 parts per billion!). Larger-but-still-small concentrations (10 to 100 parts per billion) can cause reduced feeding or reproduction in adult fish. And as the spill moves onshore, intertidal organisms, as well as shore birds, are affected.

Large spills are the most spectacular, but it is the day-to-day operations of oil tankers and daily life in coastal and river communities that actually do the most damage.

Materials:

- pencils
- protractor
- pan of water for each group of students
- small oil sample
- bird feathers
- pondweed or seaweed
- eyedroppers
- sand
- paper towels
- detergent
- string
- oil absorbent material
- worksheets:
  ...Ocean Oil Pollution (4F)
  ...Oil Spills and Clean-up (4G)

Procedure:

1. Distribute the worksheet Ocean Oil Pollution, adapted from an oil spill packet developed by the Ohio Sea Grant Program. Students will need pencils and protractors. (Answers: degrees in column 3 from top to bottom: 36°, 79°, 11°, 36°, 112°, 47°, 4°, 36°--this totals 361° if students round off the degrees; 1a. tanker accidents; 1b. 3 percent; 2a. coastal facilities; 2b. 13 percent; 3a. tanker operations; 3b. 22 percent; 4. well blowing up, drilling rig sinking, transferring oil from the rig to ship or pipeline; 5a. runoff from roads or trails, people dumping oil, seepage from dumps, vehicle going in water, boat engine use, especially if it's not working properly, etc.; 5b. rain or snow falling on the road and then dripping into the water; 6a. answers will vary, but one potential increase is from offshore drilling, due to the greatly accelerated leasing and drilling program as well as to the difficulty of drilling under northern storm and ice conditions; 6b. answers will vary, but decreases depend a lot on all of us, and also on any changes in oil production and transportation.)

2. Now have the class try to mop up their own spills. Divide the class into teams and pass out the worksheet Oil Spills and Clean-up, adapted from the Ohio Sea Grant "Oil Spill!" activity packet with the help of Jennifer Allison Keim of the Scammon Bay School.

Have students begin reading and answering the first four questions while you give each group a bowl or pan of water. (The containers should be ones you do not mind getting a little oil on!) Set out a small container of oil. One film canister full is enough for the whole class. Use a heavy- duty oil such as old crankcase oil, if possible, but any type will do. Also put out a few bird feathers, pondweed or seaweed, eyedroppers, string, scissors, sand, paper towels, dishwashing detergent. Obtain oil-absorbent material that is used for mopping up "real" oil spills from hardware stores or marine supply catalogs.

(Answers: 1. a big tanker crashing on the rocks near a salmon stream during spawning season; 2. and 3. diesel and heating oils are the most poisonous, while heavy crude and fuel oils are worse for smothering animals; 4. No. Rocky shores clean themselves the most easily, by wave action. Bays, estuaries and marshes have few waves and the oil stays much longer.; 5. Yes; 6. answers will vary; 7a. answers will vary; 7b. bottom organisms will sicken or be smothered ; 7c. No. too many bad effects on bottom organisms; 8. fairly well; 9. by breaking up the oil droplets; 10. tremendously; 11a. it coats the plant; 11b. It would keep them from getting enough light to produce food. Remind students, too, that the phytoplankton (tiny floating plants) produce a large percentage of the world's oxygen, besides being the basis of the ocean's food web; 12a. it sinks; 12b. it would lose its insulation and ability to float, and it might accidently swallow some oil and poison itself; 13. wind; fog; ice; extreme cold temperatures; storms and waves (up to 100 feet or more in the Bering Sea and Gulf of Alaska); and spills occurring far away from population centers where the spills would be more likely to be spotted when they first occur, and therefore more easily cleaned up.)

3. As a finale, read the following article to your students about some hopes for the future.

OIL BUGS AND OIL BIRDS

"OIL BUGS AND OIL BIRDS" is excerpted from Alaska Tidelines, Volume IV, Number 5, February 1982. Virginia Sims, editor. Copyright © 1982, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Permission for this use granted by The Society, Box 4-EEE, Anchorage, Alaska 99509.

Most living creatures give oil a wide berth. But there are tiny bugs that lap it up and lick their chops for more. They are a kind of bacteria called petrophiles. (It's a good name, since petro is short for "petroleum," of course, and "philes" comes from the Greek philos, meaning "fond of.")

Petrophiles can chew up petroleum products anywhere--even the asphalt used in making blacktop for highways. But they find oil mixed with water most to their liking. The more they eat, the faster they multiply, and the quicker the oil is cleaned up. When the bacteria re-enter the food chain, the oil is completely harmless.

But the trouble is that while petrophiles have huge appetites, they are fussy eaters. Each of the 70 different species that make up this family feeds only on certain parts of the petroleum hydrocarbons.

So scientists have been working to develop a "super bug" that will clean up the whole mess. They already have developed a strain that will eat about two-thirds of the chemicals involved in an oil spill. Now they are looking for one that will take care of the leftovers.

The fork-tailed storm petrel likes

oil, too. But far from being a finicky eater, this small, gray sea bird scoops up anything and everything floating on or near the surface of the water--oil, garbage and bits of plastic, along with the usual sea bird diet of fish and plankton.

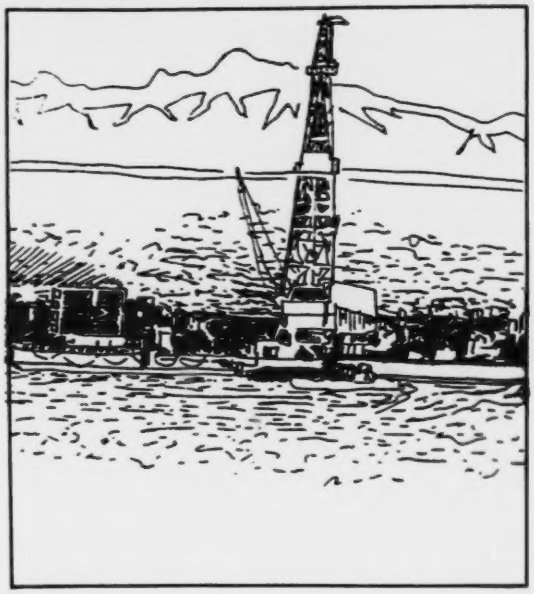
But when it is frightened, the fork-tailed storm petrel defends itself by throwing up--on the theory that the bad smell will turn off its attackers. This rather revolting habit makes it an ideal spy in the sky for checking on oil spills in the open ocean.

In recent studies, scientists under the direction of Dr. David Manuwal of the University of Washington caught fork-tailed storm petrels in fine "mist nets" as they returned to their nests at night on the Barren Islands north of Kodiak. When the birds were removed from the nets, they dumped their dinners into the scientists' sample bottles and were released to fly back for more.

By studying the glop, scientists can get an early warning of spills that otherwise might not be spotted. And eventually, they may be able to use the birds to find out where the oil came from.

The above article is excerpted from Alaska Tidelines (see credit at beginning).

Activity 4
Offshore Drilling



Background:

The 1969 Santa Barbara oil spill released a powerful surge of public concern about the environmental effects of exploring for and producing oil and gas from the outer continental shelf. This focus on oil spills, while understandable and legitimate as far as it goes, has obscured other subtler issues regarding offshore oil.

At the root of the problem is what resources we should give priority to: offshore oil and gas? onshore oil and gas? coal? nuclear? hydro? conservation? solar and other renewables? Commitments to offshore leasing by governmental and industrial resources means that those resources cannot be devoted to other energy sources. Several national energy analyses have concluded that foreign oil imports could be eliminated if the nation were aggressively pursuing energy conservation.

Are the risks arising from offshore oil and gas acceptable in light of our ability to secure energy from other sources? Do we know enough about the cumulative effects of oil operations at sea to expand the offering of offshore lands by (say) twenty times in the next five years? More than half the U.S. total--more than 500 million acres--is off Alaska's coast.

Headline-grabbing, catastrophic oil spills can definitely have significant and long-term adverse effects on ecosystems, but routine discharges are even more serious. They can amount to millions of gallons over the life of a single well, and because their stressful effects are cumulative over a long period, they are more difficult to observe and measure. And today, when economic analysis is so prevalent, how do we quantify the value of a healthy ecosystem? For instance, estuaries and other coastal wetlands provide nursery grounds for 70 percent of the nation's commercial fish. But how can one calculate the value of wetlands in comparison to a barrel of oil, which has a price fixed in the marketplace?

What should our national offshore oil policy be? Should we continue at the present pace? Should we expand? Should we slow down while further research is conducted and alternatives explored? Oil is a mighty precious commodity, as well as a nonrenewable resource. What we use now will not be there for future generations. But any way we look at it, oil will be an important issue for students to grapple with both today and in succeeding years. What will be their solution?

(Adapted from "OCS Development: What Value--What Cost" by Michael Weber in Environmental Education Report, June/July 1982.)

Materials:

- pencils
- pens
- paper
- addresses of oil related agencies, oil companies, and political representatives
- local people involved in the offshore drilling issue
- worksheets:
  - ...Above and Below the Sea Floor (4H)
  - ...Oil in Troubled Waters (4I)
  - ...Riches and Risks (4J)

Procedure:

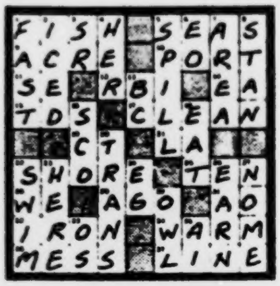
1. Discuss the current offshore drilling issue. Encourage students to collect newspaper and magazine articles about what's happening now. Distribute the worksheet Above and Below the Sea Floor. Talk about the various offshore oil-planning areas. Which one is closest to your community? (Answers: 1. Diapir Field--a diapir (DIE-uh-peer) incidently, is a strange mound of sedimentary rock that lies buried beneath the sea floor. It is formed by underground pressures and often contains oil; 2. 8; 3. 600 days; 4. Alaska-Canada border)

2. Invite people concerned with offshore leasing to present their points of view. Check with the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, National Marine Fisheries, Native corporations, the oil companies, and environmental groups. Discuss community changes resulting from offshore drilling operations. If possible, obtain the films Kachemak Bay Story (about

the fishing and oil industry in Homer) and Uncertain Summer (about the preparation for the oil industry by the people in Yakutat and other southcentral communities).

3. Use the worksheet Oil in Troubled Waters to produce a program for your school or community or local TV station. Add examples or viewpoints from your local area to make the presentation more meaningful.

4. Now try the worksheet Riches and Risks for a brain teaser crossword. (Solution below:)



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S	E	■	R	B	I	■	E	A
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S	H	O	R	E	■	T	E	N
W	E	■	A	G	O	■	A	O
I	R	O	N	■	W	A	R	M
M	E	S	S	■	L	I	N	E

5. End the unit by having students write letters stating their points of view to legislators, oil companies, Native corporations, local city council, newspapers and the governor. This should encourage the development of language arts skills and stimulate critical thinking.

Unit Five
Community Planning Along Our Coasts and Rivers

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    Local Wetlands 5E
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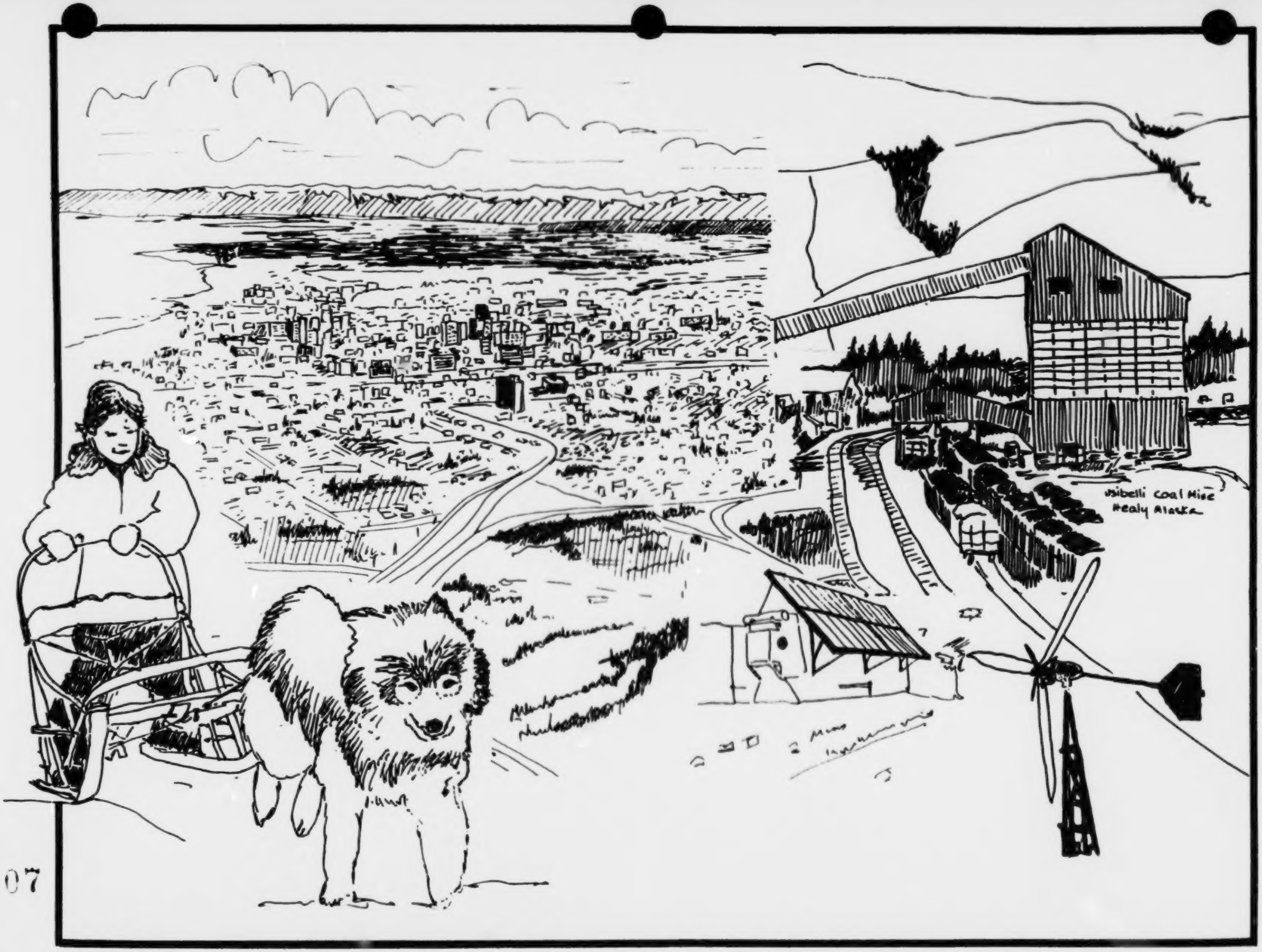
Activity 5: Community Issues 99

Objectives:

To help students:

- Read about Alaska's energy sources (Activity 1).
- Diagram local community energy sources (Activity 1).
- Survey home and school energy uses (Activity 1).
- Build and race a model sailboat (Activity 1).
- Map the transport of goods and services to the community (Activity 2).
- Write a theme about the effects of oil on transportation (Activity 2).
- Investigate local transportation sources and issues (Activity 2).
- Estimate the percentage of transportation that is water-dependent (Activity 2).
- Classify and investigate nearby wetlands (Activity 3).
- Interview people involved in wetlands management (Activity 3).
- Publish a wetlands newspaper (Activity 3).
- Record and graph recreational activities for a week (Activity 4).
- Compare and contrast different types of recreation (Activity 4).
- List recreational water safety needs (Activity 4).
- Investigate and contribute to local recreational needs (Activity 4).
- Choose a local problem and come up with a class solution and plan to implement it (Activity 5).


Usibelli Coal Mine
Healy Alaska

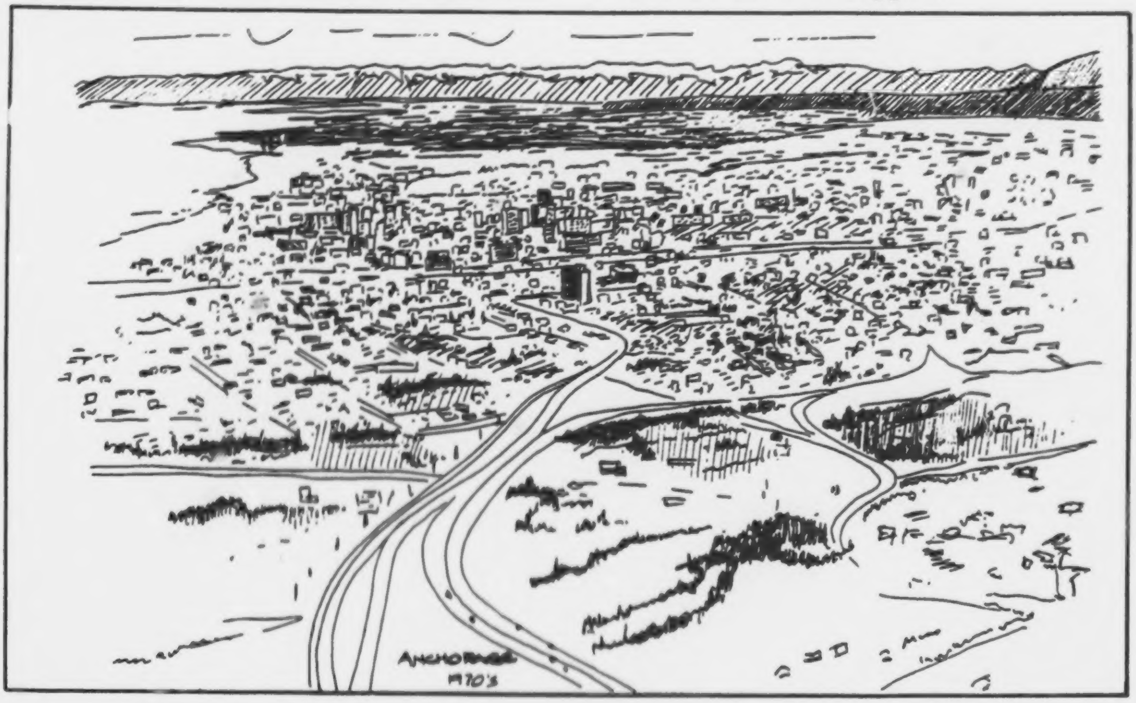
UNIT FIVE: Community Planning Along our Coasts and Rivers. Clockwise from upper right are a coal mine, a windmill and a solar panel, a dogsled and a scene of urban Anchorage--all elements to be considered in a discussion of planning for Alaska's transportation and energy needs.

Communities in Alaska usually have a wide variety of local resources, and the people in these communities usually have a wide variety of opinions on how these resources should be used. Such diversity should make this unit exciting, as you and your class reach into the community to find out more about where you live. Do a community inventory (Unit One, Activity 1) and then select one or more of the following topics to study in depth: energy; transportation; wetlands; recreation. Though we have separated out different subjects, these areas overlap tremendously, and are all part of the whole situation that applies to your locale. The last activity in this unit contains guidelines for community problem solving.

A wide variety of personal needs and interests exists in any community, big or small. Sometimes, the needs of one group are in conflict with the needs of others.

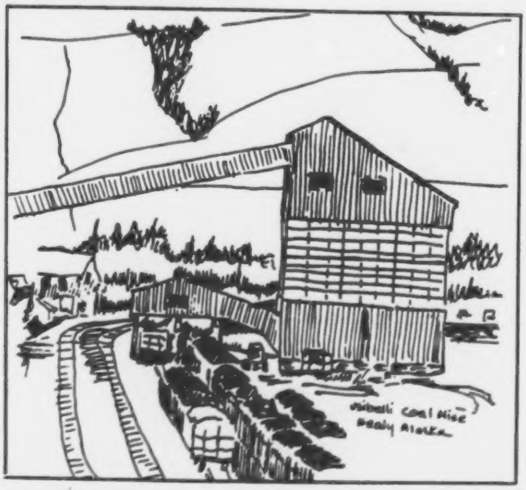
Careful planning can often result in everyone's needs being met as the community develops. We accomplish this planning almost automatically on the family level. Mothers and fathers are usually experts at this. As communities get larger, however, the problems become more difficult.

Community planning has not always been done properly in the past, resulting in increased costs, loss of income and loss in the quality of life to local residents. Some of our largest cities exhibit the same problem on a larger scale and consequently are losing population as people move away. Usually, the failure to plan for high quality community development results from the influence of powerful special interest groups that ignore the needs of others. Ideally, when people of good will get together to plan for the needs of everyone this should not happen.



Activity 1
Energy Sources

Note: Much of the material in this section is excerpted, adapted and updated from Alaska Tidelines, Volume III, Number 1, September 1980. Virginia Sims, editor. Published by the University of Alaska Sea Grant College Program, Copyright © 1980. Reprinted by permission.



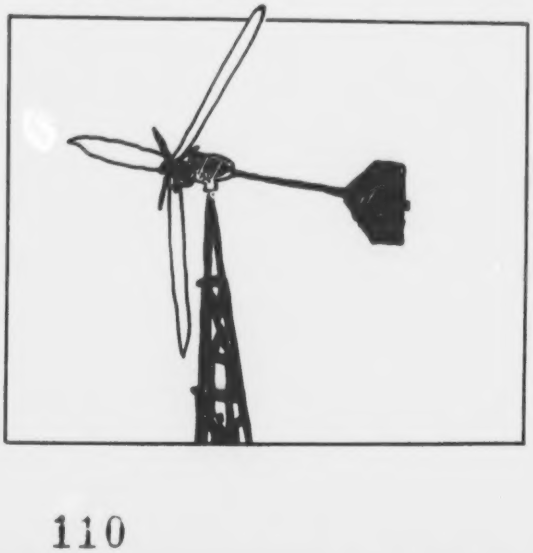
Background:

The choice of energy sources has a tremendous influence on costs and lifestyles in coastal and river communities. Alaskans have a wide variety of energy sources among which to choose: oil, coal, natural gas, wind, solar, geothermal and hydropower. But at the same time, we will one day run out of nonrenewable sources such as coal, oil and gas. Therefore, this activity focuses on renewable resources, especially wind, because wind has been used on our seas and rivers for centuries to propel boats and ships.

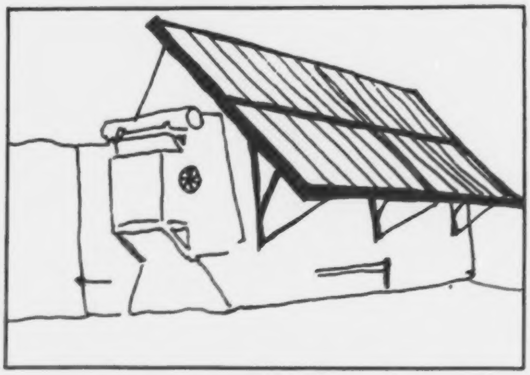
A few commercial fishing boats in southeastern and southcentral Alaska are using WIND to beat the high cost of gasoline and diesel fuel. It wasn't too long ago when all the people fishing in Bristol Bay used sailboats. Onshore, windmills seem like a natural for Alaska, where the winds blow longest and strongest during the dark winter months when the need for power is greatest. Any area where the wind averages 10 to 12 miles an hour or more is a good place for a wind-powered generator. That includes most of Alaska's island, coastal and flat delta regions, as well as the high hills and narrow mountain passes in the Interior.

Historically, windmills have been used for grinding flour (that's where the "mill" comes from) and pumping water. Only recently have they been adapted to change mechanical energy into electric energy. (The most common way to make electricity is by using the power of wind, water or steam to turn a wheel to cut the force field between two magnets.)

A major problem with windmills, of course, is that they only work when it's windy. Nevertheless, at remote sites the power they generate can be stored in heavy-duty batteries for use on windless days. And when they are tied in with a village diesel system that takes over when the wind is still, a steady source of power is supplied at far less cost.



SOLAR energy also offers a lot of potential. What other state gets as much sun as Alaska in the summertime? And by having a large storage capacity, this power can be used right on through the winter. Solar power can be used for electricity as well as heat. The owner of Cripple Creek Gas Station in Fairbanks, for example, runs his entire household--washing machine, stereo, TV, lights, etc.--on sun-powered photovoltaic cells and storage batteries, supplemented by a generator, all through the year.



Hot springs and steaming volcanoes are outward signs of an underground source of power called GEOTHERMAL (GEE-oh-THERM-ull) energy. The word means "earth" (geo) "heat" (thermal). And the energy is drawn from the fiery core of partly melted rocks and minerals that lie beneath the earth's cool crust.

The earth's crust is generally 15 to 30 miles thick. But it isn't all solid. Instead, it is made up of huge plates that move ever so slowly, sliding above and below each other, bumping together and drifting apart. In the process, the hot molten lava sometimes comes close enough to the earth's surface to heat ground water or even blast through in the form of a volcano.

Alaska is a young land still forming. You can feel it in our frequent earthquakes, caused by bumps and grinds deep inside the earth. In addition, our 88 active volcanoes and more than 100 known hot springs make Alaska a prime spot for the development of geothermal power.

Water from hot springs can be piped in to heat homes (as is already being done in Boise, Idaho, and Klamath Falls, Oregon). And if the water is very hot--356°F or more--the steam can be used to generate electricity.

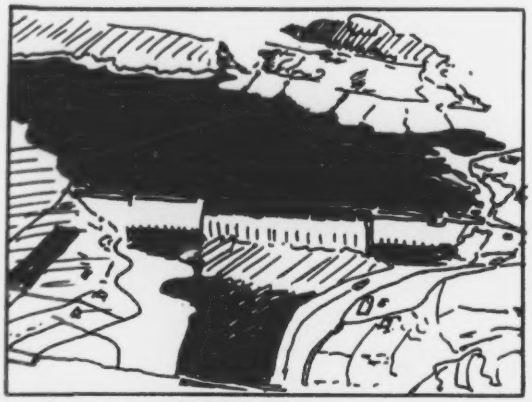
A hot spring is formed when cold water sinks down through a fault in the earth's crust and passes through soft rocks heated by the layer of molten lava below. Then it rises through another fault and bubbles up as a hot spring. Resorts in Circle, Manley, Chena Hot Springs and other places in Alaska use hot springs directly to heat their cabins and bathhouses as well as their swimming pools.

At Pilgrim Hot Springs, 50 miles from Nome, the state has funded a project to determine the feasibility of using geothermal energy for various pruposes. Now private proposals are being developed to use heat energy from the springs for, among other things, commercial-sized greenhouses and reindeer calving barns.

Across the Unalaska Bay in the Aleutians, the Alaska Power Authority has drilled an exploration well in a volcano and hit a "geothermal resource"--hot water in the ground--at 2000 feet. The next step will be to do a feasibility study, but researchers are optimistic that the ground water will be able to provide energy plentiful enough to supply Unalaska Dutch Harbor and to attract fish processors.

HYDROELECTRIC power is made by turning wheels with falling water. [Hydro (HIGH-dro) means "water" in Greek.] A small waterfall can do the job. But the higher the falls and the more water flowing over them, the more power that can potentially be generated. For this reason, a dam is usually built across a river or stream to back up the water in a man-made lake, so that the height of the falls and the water flow can be controlled.

Along with all its other resources, Alaska has more than one-third of the nation's remaining unused hydroelectric sites. But except for a few large projects, such as Snettisham near Juneau or Eklutna near Anchorage, most are designed to serve just one community.



Not that Alaska can't think big. In the 1960s, there was much talk about building a dam near Rampart on the Yukon River, which would have produced twice as much power as any other dam in the world by backing up a body of water larger than Lake Erie. From time to time, there is also talk of harnessing Cook Inlet's huge tides. That, too, would be a super-project, involving construction of low dams across Turnagain and Knik arms to generate power as the water flows in at high tide and out at low tide.

Although the tidal power plan has possibilities, the proposed Rampart Dam is almost forgotten. Big dams can create big problems. Lands flooded by the back-up lake are lost to moose, caribou and other wildlife. And changes in the water flow can damage downstream areas as well.

Today, arguments are raging over a proposed project on the Susitna River, which would provide nearly twice the electricity now used in the whole Anchorage-Fairbanks railbelt area. Backers say that low-cost dependable power would bring industrial development to the area and much-needed jobs. Opponents argue that bigger isn't necessarily better, and that a number of smaller hydro projects would be less damaging to the environment.

The source of energy that's most often forgotten--yet offers some of the biggest potential--is CONSERVATION. It's cheaper to save a barrel of oil than to produce an additional barrel. Scandinavian countries, for example, use half the energy per capita that we do, yet they have a comparable standard of living. And it's not just our big factories, businesses and school buildings that are using energy. Personal use of energy--home heating, lighting, air conditioning, cooking, refrigeration and transportation--account for 37 percent of the country's energy use. Alaskans may not need much air conditioning, but they sure make up for it in transportation needs--both in terms of goods and services from the Lower 48, and of in-state and out-of-state travel and communications.

In summary, our energy choices and uses are a big determinant of our coastal and river life styles and community profiles. Our choices today will determine our future life styles and what resources will be available for future generations.

Information in Activity 1 is largely adapted from Alaska Tidelines (see credit at beginning).

Vocabulary:

- geothermal
- hydroelectric
- wind generator
- photovoltaic cells
- heat pumps

Materials:

- pencils
- paper
- wood blocks (1 per student)
- disposable aluminum pie plates or frozen food containers for keels
- sticks or slender dowels for masts
- masking tape
- glue
- scissors
- pieces of plastic or cloth for sails
- needles
- heavy-duty thread
- felt-tip marker
- thumbtacks
- paper clips
- knives
- books about sailing
- worksheets:
  - ...Alaska's Powerhouse (5A)
  - ...Sun Power in Alaska??? (5B)
  - ...Energy Hog or Energy Hoarder (5C)
  - ...Beating the Energy Crunch (5D)

Procedure:

1. Begin by discussing energy sources in Alaska. Pass out the worksheet, Alaska's Powerhouse. (Answers: 1. Aleutians: wind and geothermal, Southeast: water (hydro) and geothermal plus maybe wind; 2. 800 miles; 3. coal; 4. oil, natural gas, coal, water, and geothermal; 5. Barrow; 6. 2,500 miles, 60 miles; 8. answers specific to your community.)
2. What potential does Alaska have for solar energy? Have students try the worksheet Sun Power in Alaska??? (Answers: 1. Barrow, Juneau; 2. Barrow; 3. Palmer; 4. Fairbanks)
3. Mention that conservation is an important way to save energy. Have each student try the worksheet, Energy Hog or Energy Hoarder? Discuss answers as a class. For more information on conservation, write to the U.S. Dept. of Energy, Editorial Services, Public Affairs Office, Wash. DC 20585; Alaska Div. of Energy and Power Devel., P.O. Box 3535, Anchorage, AK 99510; or Rich Seifert, Energy Specialist, Univ. of Ak, Coop. Ext. Serv., Eielson Bldg., Fairbanks, AK 99701.
4. Discuss energy sources in your local community. Have each student make a diagram of all energy sources and their uses in your community. Have each student list current prices of the various fuels and electricity costs. Discuss how energy influences life styles in your community. What do higher fuel costs mean to fishing boat captains, to canneries, to the price of fish?
5. Give students a chance to design their own energy systems. Pass out the worksheet Beating the Energy Crunch.

6. For a finale, have students make and race sailboats to illustrate wind power. To set the mood, read passages to the class about old-time or present-day sailing. The film Down to the Sea in Ships has footage of old-time sailing ventures and some of the incredible winds and seas they faced coming around Cape Horn. Have each student carve a wood block and a hole for the mast (twig or wood dowel). Glue the mast into the hole. Add a keel (piece of aluminum) with thumbtacks. Add paper clips to the keel for more weight. Use masking tape or needle and thread to attach the sail (piece of plastic or cloth) to the mast. Use a thumbtack plus some thread to attach the sail to the deck. Have students give their boats names and decorate them with felt-tip markers.

Pick a breezy day for a class regatta outdoors, or set up a tank with student wind power (or a fan) indoors. Have students experiment with different-shaped boats, different sail settings, different weights, different wind speeds. Students can award badges to captains of the fastest boat, slowest boat, ugliest boat, most beautiful boat, boats that flip over the most times, and so on. Ask students to predict what role sailboats (or sailing ships) will play in our future. (Adapted from "Science Activities in Energy," developed by the staff of Maurice Gould for the American Museum of Science and Energy.)

Activity 2
Transportation

Background:

Alaskans are great travelers. Each year they log thousands of miles traveling to jobs, meetings, berry picking, hunting, fishing, and to visit friends and relatives in a state so big that it covers five time zones (though for convenience most of the state is now in one time zone). Additionally, most of Alaska's goods and supplies are transported from the Lower 48 by ship, truck or plane. Studies have shown that 47 percent of Alaska's energy budget goes for transportation.

Each community has a unique transportation system, oftentimes consisting of boats, planes, three-wheelers and snowmachines. Many communities are deciding whether to tie into the central road system, which would make it easier for them to "get to town," but would also make it easier for "town" to get to them.

Materials:

- Alaska map
- world map
- chalkboard and chalk

- yarn
- felt-tip markers
- thumb tacks
- slips of paper

Procedure:

1. Ask students to list on the chalkboard all the different means of transportation they can think of. Circle the ones most important to your community.

2. List all the goods and services arriving in your community. Have students inventory the food and materials found at home and school, listing the states or countries of origin.

3. Compile your results on the world map: on little slips of paper, write the names of the items on your list of goods imported into Alaska. Place these tags in countries or states on the map that export these products to Alaska. Connect these places to Alaska with yarn.

4. Point out on the Alaska map how these products get to your community.

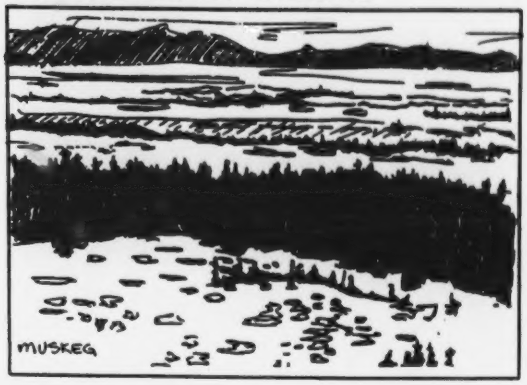
5. Estimate the percentage of transportation that is water-dependent. Also estimate what percentage of the products' costs is from transportation. What would happen if fuel costs escalated tremendously? What would happen to transportation within your community? At what point would products from the "outside" be unaffordable? What jobs would be affected?

6. Have students write themes on "The Day that the Oil Stopped Flowing," imagining what their communities would be like without the oil and gas that transport people and goods. What would happen to subsistence, sport and commercial fishing?

7. Have students pick a local transportation issue to explore. Is the barge, ferry or riverboat service adequate? Is your community expecting a new road, airport or harbor? Do you need additional trails along or to the beach, the river or a nearby lake? Are snowmachines and three-wheelers being used to carry and haul supplies as well as for recreation? Are there conflicts between people who use the trails for skiing and hiking and people who drive motorized vehicles along them?

Students can collect information from a variety of viewpoints. Visit the site (if possible) and inventory and photograph what is there now; brainstorm alternative solutions; come up with a class solution; and develop a plan to implement that solution, which may include talking to the decision makers, writing letters and/or a news article, preparing a slide show or charts and graphs. Discuss what will make the most impact. Often, just talking to the right person is more important than anything else. Then implement your plan. Evaluate it afterwards. What would the class do differently the next time?

Activity 3
The Wetlands Gazette

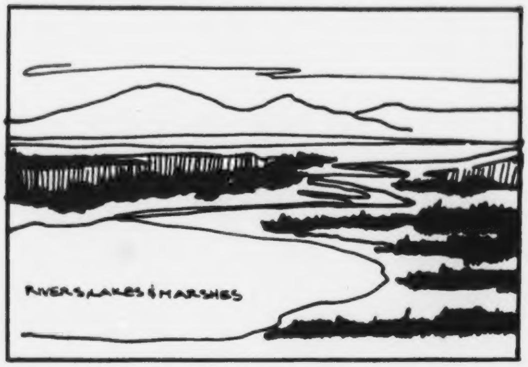


Background:

Most of Alaska is wetland, which means land that is wet most of the year and is occupied by plants and animals that prefer wet soil. All wetlands have either an impermeable or semi-permeable substrate at the bottom--such as bedrock or permafrost--through which water either cannot escape or escapes very slowly.

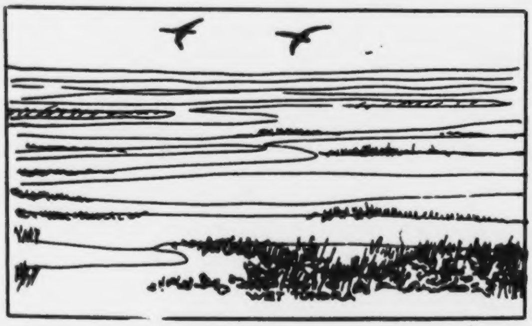
Alaska has a variety of wetland types: coastal wetlands; wet tundra; muskegs; and rivers, lakes, and marshes.

Rivers, lakes and marshes are common in Alaska's Interior. Cattails, horsetails, mare's tails, sedges, rushes and grasses are typical freshwater marsh plants.



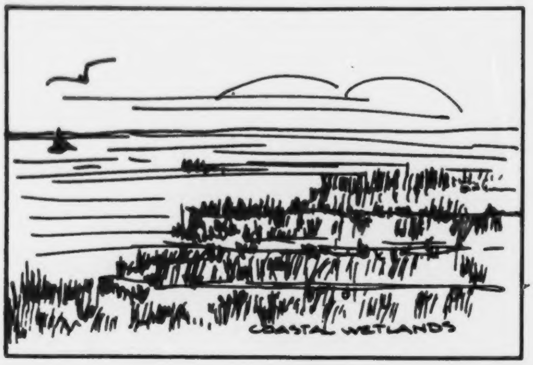
Rivers and lakes are called wetlands, too, because they host a variety of water-loving plants and animals--and the land underneath these water bodies is definitely wet.

Wet tundra, one type of wetland found in northern and western Alaska, is characterized by low-lying plants such as grasses, sedges, cranberry, blueberry, crowberry, lichens and willow.



Muskegs, or bogs, are freshwater wetlands that contain cold, acidic water and spongy or floating mats of vegetation, such as sphagnum moss, cranberry, sundew (a predatory plant) and Labrador tea. Black spruce are often associated with Interior bogs. Lodgepole pine is found in muskegs in Southeast Alaska.

Coastal wetlands include tidelands, estuaries, salt marshes, river deltas and barrier-island lagoon systems.



Tidelands are coastal lands washed by the tide. Tidelands include sand, mud and rocky beaches, plus saltwater marshes. Salt marshes are formed where salt water washes over sedges and grasses. Estuaries are formed where rivers and streams meet the sea. They include bays, lagoons, rivers and adjacent river delta wetlands--which combine together to form extremely productive areas. The mixing of salt and fresh water in the shallow estuarine waters creates a warm soup of nutrients and food, gently stirred by wind and tide. Estuaries are the nursery grounds for the great majority of fish and shellfish.

Barrier-island lagoon systems are important to the ecology of the Arctic coastal plain, the Alaska Peninsula, and the Copper River Delta. They provide a protected lagoon system where fish, migratory birds and marine mammals can feed on abundant invertebrate and fish resources.

Swamps, a type of wetland characterized by flooded trees, are found in southeastern United States, but not in Alaska.

All these wetland types are generalized. They integrate and overlap. River deltas, for instance, may include freshwater marsh, tundra, tideland (saltwater marsh and sandy beach), plus be part of an estuarine system. Wetland terms are quite arbitrary, but they do serve to familiarize students with wetland concepts.

People nationwide are beginning to realize the value of wetlands economically, ecologically, recreationally, aesthetically and educationally. In the not-too-distant past, many people simply assumed that wetlands were no more than wastelands to be drained, dredged and developed. As a result, vast areas of wetlands were routinely destroyed as developmental pressures increased for roads, homes, airports and factories. Unfortunately, wetlands are still being lost today, despite the fact that more and more people are realizing the necessity to protect our remaining wetlands.

Wetlands are critical fish and wildlife habitat. The commercial fishing industry depends on the protection of coastal wetlands, which are breeding and nursery areas for 70 to 80 percent of commercially caught fish and shellfish. Alaska is also one of the prime duck and goose "factories" for North America. Our wetland habitats provide nesting and rearing areas for millions of waterfowl and shorebirds. Moose, caribou, mink, muskrat, beaver and berries are but a few of the many other animals and plants that depend on wetlands.

Other wetland values include subsistence and sport hunting, fishing, trapping and recreation, as well as being an extraordinary tourist attraction. Wetlands decrease or eliminate downstream flooding by acting like a sponge, soaking up excess rain and snowmelt. Wetlands are natural storm buffers as they physically shield coastal lands from the effects of high winds and seas. Surface water that collects in wetlands gradually seeps down to replenish underground reservoirs, which often serve as community water supplies. Wetlands also act as biological filters, straining out pollutants such as sewage, chemicals, silt and other garbage (all within limits!).

In the past, development on wetland areas has been more or less helter-skelter. Consequently, just about every community has examples of development that should have perhaps occurred in other places. The prime mechanism for wetland regulation is the so-called "404" regulatory permit program. The U.S. Army Corps of Engineers manages these 404 permits, and anyone wishing to fill, dredge or construct a project on a wetland has to get a permit from them. The Corps of Engineers works with the applicant by: notifying the public; reviewing the site; discussing the issue at a public hearing; evaluating the site for conservation, economics, aesthetics, environmental concerns, fish and wildlife values, flood damage prevention, public welfare, historic values, recreation, land use, water supply, water quality, navigation, energy needs, safety, and food production; suggesting changes to meet 404 regulations; and issuing the permit.

Vocabulary:

- tundra
- bog
- muskeg
- swamp
- tideland
- estuary
- marsh
- delta
- barrier island
- lagoon

Materials:

- paper
- pencils, pens
- copy machine
- typewriter
- film
- camera
- worksheets:
  ...Local Wetlands (5E)
  ...Life in a Wetland (5F)

Procedure:

1. Discuss the meaning of wetlands and point out examples of nearby wetlands. Distribute the worksheet Local Wetlands and have students identify types and categorize local examples. (Answers for the types: 1. wet tundra; 2. coastal wetlands; 3. rivers, lakes and marshes; 4. muskeg)

2. Discuss wetlands values. Distribute the worksheet Life in a Wetland and have students write their own descriptions of the drawing. How many different ways are people and animals using the wetlands? What conflicts may exist between the different uses?

3. Discuss the need for educating your community about wetlands values. Suggest the idea of printing and distributing a Wetlands Gazette. You'll need students to interview community members, write articles, take pictures, draw cartoons, do layout and printing and distribute the paper. If you have time, students might want to ask a local bank or a community resident for a loan to cover newspaper expenses; then sell advertisements; and sell the paper to pay back the loan or raise money for a class project, all of which would be a great lesson in economics.

4. Develop a plan for producing the Wetlands Gazette. Ask the students:

- Who should we interview for wetlands articles? (biologists; subsistence, commercial, and sport hunters and fishers; developers; government agencies; conservationists; long-time residents; local officials; or someone who's gone through the 404 permit process)

- What wetlands uses are going on or have gone on in our area in the past? (housing developments; roads; airports; harbors; parks)

Pick a theme and one or more of the wetland areas to study. Plan a field trip(s) to take pictures, do biological studies, and hold interviews. Your local newspaper staff or resident writers/photographers may be able to give your class technical pointers. Be sure to mention the importance of accuracy, and that opinions belong on the editorial page or as quotes of people interviewed. Additional wetlands information is in other volumes of the Alaska Sea Week Curriculum Series. For information on the 404 Permit Process and local or area-specific examples, write to the U.S. Army Corps of Engineers, P.O. Box 7002, Anchorage, Alaska 99510.

5. Produce your Wetlands Gazette and distribute it in your community. Be sure to send copies to the local or area television and radio stations and newspaper offices. What is the community reaction? Figure out a way to measure the success of your Wetlands Gazette by questionnaires, verbal or written comments.

Activity 4
Recreation

Background:

Recreation is not only a multimillion dollar business, but it consumes much of our spare time as we boat, hunt, fish, scuba dive, ski, hike, swim, walk, canoe, knit, carve wood, watch TV, play video games, read books, jog, drive cars, ride three-wheelers and snowmachines, mush dogs, or fly planes and hang gliders. The type of recreation we choose affects the environment directly, as we move through rivers, ocean, wetlands, forests and mountains. We affect the environment indirectly as resources are used up to manufacture recreational equipment, transport it, sell it and maintain it.

The type of recreation that community residents participate in affects their character and way of life. Many Alaskans spend much of their recreation time outdoors. Safety is a most important consideration, not only on land but in the water. Alaska has more per capita water-related accidents than any other state, and many of these deaths occur during recreational pursuits.

Materials:

- chalkboard and chalk
- paper
- pencils
- graph paper

1. List on the chalkboard all the different types of recreation your students participate in. Have them keep track of the amount of time they spend in each pursuit for a set length of time (such as a week).

2. Compile this information on a class chart. Pass out graph paper and have students graph their class's recreation for the week.

3. Compare and contrast the different types of recreation. Ask students the following questions:

   - How would this chart change with the seasons?

   - Which forms of recreation require the most energy resources to maintain? (oil, gas)

   - Which forms require the most energy to manufacture? (oil, gas resources)

   - Which forms of recreation require the most energy (human) to participate?

   - Which forms of recreation are water-dependent?

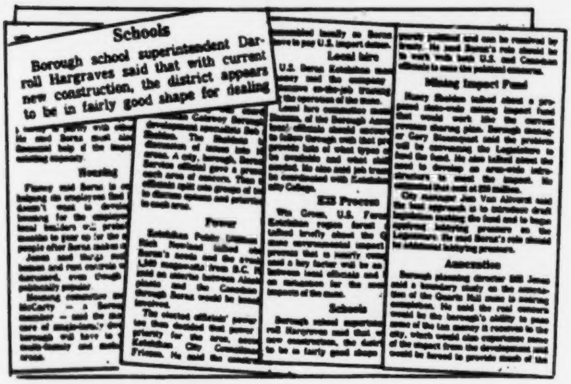
   - Which forms of recreation are the most damaging to the environment?

4. Discuss why recreation is important (peace of mind, health of body) and talk about the increase in recreation in modern times due to higher standards of living and to the fact that for major portions of the population, time need not be completely absorbed in obtaining food, clothing and shelter.

5. Bring up the need for water safety in water-dependent forms of recreation. Have students brainstorm all the ways they can think of to be safe around the water. List these on the board. (Include life jackets, survival suits, knowing how to swim, proper boat handling, knowledge of water and weather conditions. See safety and survival portions of Units 7 and 8.)

6. Discuss local recreation needs. Does your community need a swimming pool? More trails along the beach and river? A waterfront park? Square dances? A youth center? Water safety training? Select an issue the students are interested in and then follow the steps mentioned in Activity 5, Procedure 3 of this unit, to study the topic in-depth and maybe contribute toward improving local recreation opportunities.

Activity 5
Community Issues


Schools
Borough school superintendent Darroll Hargraves said that with current new construction, the district appears to be in fairly good shape for dealing
Local hire
Mining Impact Fund
Housing
Power
EIS Process
Annexation
Schools

Background:

Looking at local community issues can be one of the most exciting and rewarding topics of the school year. Students have a chance to become an integral part of the community as they contribute their ideas and expertise to issue resolution. They also learn about political realities in the process. Reading, writing, mathematics and speaking skills become very important, as students try to comprehend all the intricacies of a particular issue while attempting to influence its outcome.

By researching a variety of viewpoints, students develop critical thinking skills that should help them throughout life. Decisions in Alaska are made in a variety of ways, depending on local culture and politics. As students learn to be effective with community action, they are acquiring the confidence and self-esteem they need in order to develop into productive members of society.

Materials:

- news clippings
- resource people
- chalkboard and chalk

Procedure:

1. Begin a list on the board of local issues. Refer back to the community inventory (Unit 1, Activity 1). Which of these issues interest students the most? Is a new commercial development planned? Is a power project or road coming to your community? Where are new houses being built? What's happening to local wetlands? Do you need more trails or parks? Is public access assured to local beaches, rivers and lakes?

2. Decide which issue to study. Students may want to pick a comparatively minor problem where they have a greater chance of influencing the outcome, or they may want to become involved in a community or regional problem that may be more controversial and exciting to investigate.

3. Follow these problem-solving steps:

    a. Collect in-depth information from a variety of viewpoints. Visit the site and inventory and photograph what is there now. Read pertinent books, news articles and research papers.

    b. Brainstorm alternative solutions.

    c. Come up with a class solution. Suggest that students state their concern in a positive manner.

    d. Develop a plan to implement that solution, which may include talking to the decision makers, writing letters and/or a news article, preparing a slide show or charts and graphs. Discuss which action will have the most *impact*.

e. Implement your plan.

f. Evaluate your success (or lack thereof!). What would the class do differently the next time? You may need to go back and try again!

Unit Six
Weather

Index:

Activity 1: Weather Forecasting 103
Worksheets:
  Weather Lore 6A
  What's Your Climate?...6B
  Classifying Clouds 6C
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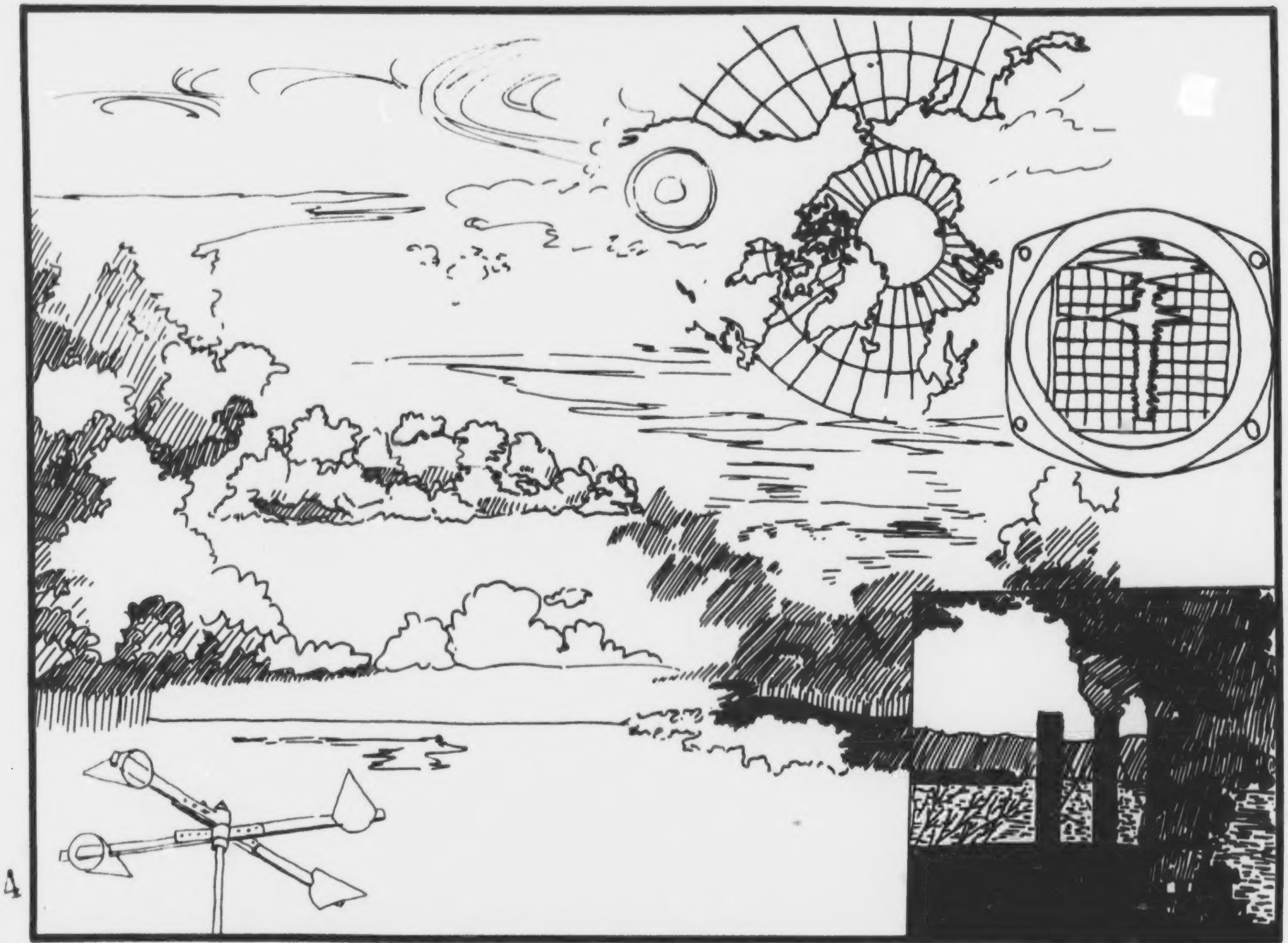
Objectives:

To help students:

- Make a weather guide with old-time rhymes and sayings (Activity 1).
- Discover how people forecast the weather for their communities (Activity 1).
- Read about Alaska's climates (Activity 1).
- Classify clouds by their descriptions (Activity 1).
- Track a storm on a weather map (Activity 1).
- Predict local weather (Activity 1 and 2).
- Construct a weather station (Activity 2).
- Record and graph local weather conditions (Activity 2).
- Read about the ways that air pollution and weather are interrelated (Activity 3).
- Test for air particulates and acid rain in the community (Activity 3).
- Inventory family and community water uses (Activity 4).
- Practice water conservation (Activity 4).



UNIT SIX: Weather. Alaska's temperature has been recorded as low as -80°F at Prospect Creek and as high as 98°F near Fairbanks. Because of the extraordinary diversity and, often, harshness of the climate, it affects all facets of people's lives including the way they eat, dress, and build their houses, and understanding how the weather works becomes highly important.

Weather determines community water supplies. With too little rain, there's not enough water to drink or wash with or use for industry. With too much rain, there are floods and overflows of sewage from treatment plants. Acid rain, which results from pollutants thousands of miles away, affects fish, wildlife and people alike. Snow, with its insulating qualities, protects animals of the north.

Weather dramatically affects life in Alaska. Pilots, boat captains and passengers are always watching the weather. All long-time travelers in Alaska have been "weathered in" or "weathered out" of destinations many times. The storms, fog, waves, wind and freezing temperatures are legendary here. Anyone who spends time outdoors in Alaska should know some weather basics.

Activity 1 Weather Forecasting

Background:

The lore and legends of peoples around the world are filled with tips for forecasting the weather. In the face of weather, we are usually quite helpless. So many of our needs and the things we do depend on weather: the amount of energy required to heat our homes; travel; outdoor work and chores; recreation; hunting and fishing; even our moods.

The study of weather is called "meteorology" (from the Greek meteoron, meaning "phenomenon"). Interest is spurred by everyone's desire to look into the future, to be able to glance at the sky and tell what the weather today or tomorrow will be. "Climate" is generalized weather, or the weather at a given place over a period of time. Climate is affected by the same conditions that affect weather--latitude, prevailing winds, ocean currents, mountains, nearness to the sea, and so on. Weather averages, totals and extremes combine to give an overall picture of climate.

Today's sophisticated weather forecasting makes use of satellite imagery and computerized data from all over the world. Yet as every weather predictor knows, weather forecasting remains far from an exact science. No substitute exists for local weather knowledge. It is most importantly a matter of safety, as storms can be much worse than predicted or can sweep through an area before a forecast can be updated.

Vocabulary:

- weather
- climate
- meteorology
- millibars
- isobars
- occluded
- barometer
- cirrocumulus
- cirrostratus
- altocumulus
- altostratus
- stratocumulus
- stratus
- nimbostratus
- cumulus
- cumulonimbus

Materials:

- pencils
- paper
- worksheets:
  ...Weather Lore (6A)
  ...What's Your Climate? (6B)
  ...Classifying Clouds (6C)
  ...Track that Storm! (6D)

Procedure:

1. Ask students how weather affects the community. Mention any local or regionally related weather disasters. What worldwide weather-related catastrophes are your students familiar with? (hurricanes, floods, typhoons, mud slides, tornadoes, blizzards)

2. Distribute the worksheet Weather Lore so students can make their own weather guides. (Answers: Predicts fair weather: 1b, 3a, 4a, 7a, 8a, 12; Predicts rain or storm 1a, 2a, 3b, 4b, 5, 7b, 8b, 9, 10, 11, 13, 14, 15b; Predicts Clearing 2b, 6, 15a) After students have a chance to categorize the sayings, discuss them further. The first saying has been recognized for more than 2,000 years. It can be found in the Bible (Matthew 16:2-3). Here's an illustration of the second saying:

The second saying is clear if you understand that windward means "toward the direction from which the wind is blowing" and leeward means "situated away from the wind."

The third saying can be explained by the fact that swallows (and bats, too) are in-flight feeders on insects. At times of high pressure (good weather), insects are carried high by air currents. At low pressure, insects are carried downwardly by cool air and their wings are heavy with moisture. The fourth, fifth, eighth, ninth and eleventh sayings are also true because of air pressure. Smoke rises in times of high pressure; sounds carry farther and so do smells; and birds perch more. And at low tide, rain is more likely. The sixth and seventh sayings point out that early morning rain and dew--just like a good morning fog--will often clear off before noon. The eighth saying points out that when the wind is veering (moving clockwise from E to SE to S), the weather is sure to clear. When the wind starts backing (going counter-clockwise from W to S, SE, N & NE), a storm is coming.

Saying number 10 is somewhat self-explanatory. Number 14 indicates cirrostratus clouds, which let the outline of the sun and moon through, and is a good rain forecaster. Number 15 refers to the fact that if a storm quickly develops, it will pass by rapidly. But if a storm takes a long time in brewing, it will probably stay a long time!

3. Now assign students the task of finding out weather lore in their own community. Ask students to interview local residents and find out old sayings and tricks to forecast the weather, as well as the direction that storms usually come from in each season.

4. Explain that climate is the accumulation of daily weather patterns. Pass out the worksheet What's Your Climate?

5. Distribute the worksheet Classifying Clouds. (Answers: 1. d; 2. h; 3. c; 4. j; 5. a; 6. f; 7. e; 8. b; 9. i; 10. g) Information for this activity was taken from the Golden Nature Guide Weather, as well as Hillcourt's and Sloane's books. Students may be interested in these additional ditties about some of the clouds:

Cirrus

Hen's scarts and filly tails
Make tall ships carry low sails.

Cirrocumulus

Mackerel sky, mackerel sky -
Not long wet, not long dry.

Cirrostratus

When sun or moon is in its house
Likely there will be rain without.

Altocumulus

Wooly sheep in a dappled sky
Will bring you rain drops by and by.

Stratus

When hill or mountain has a cap
Within six hours we'll have a drap.

Cumulus

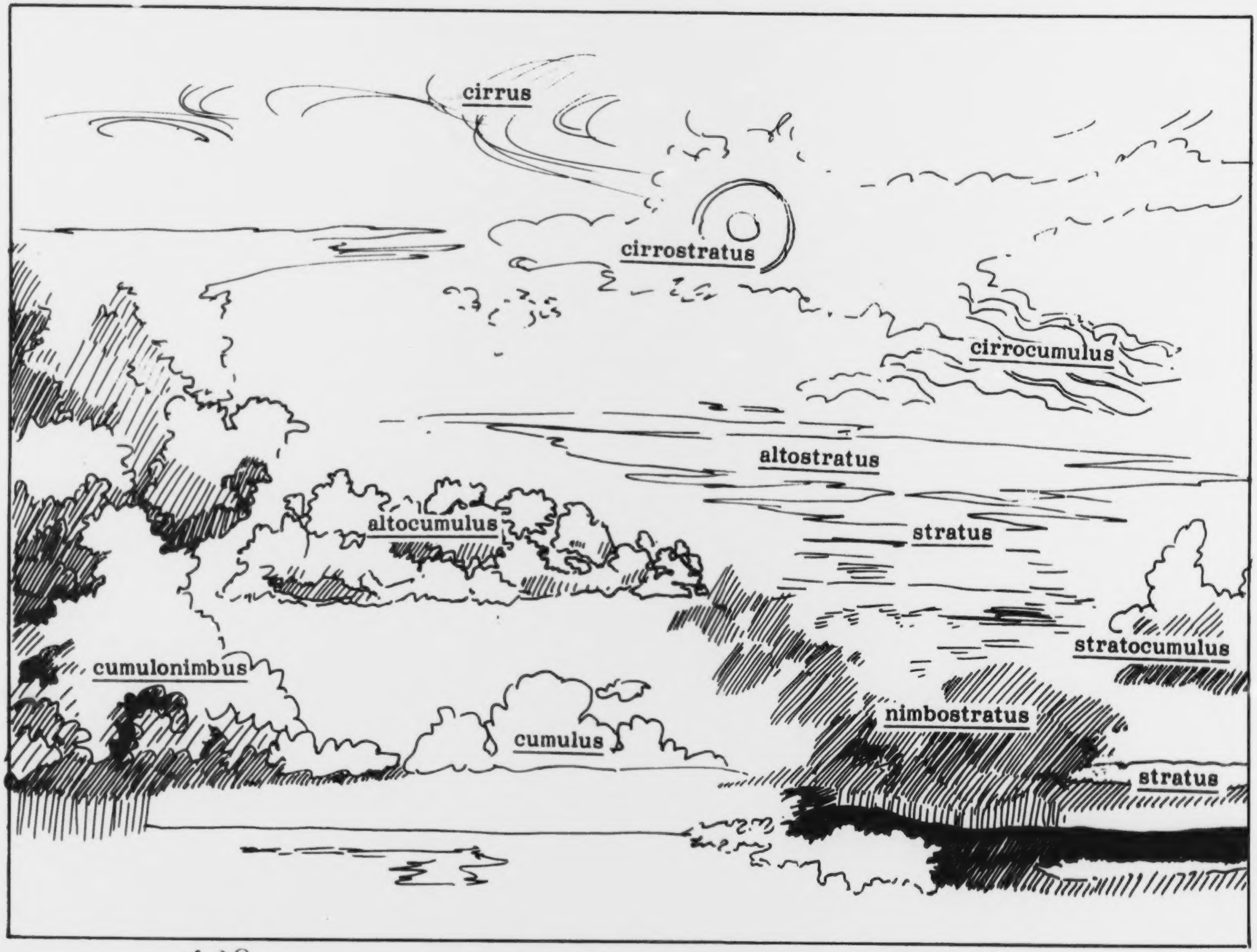
When wooly fleeces spread the heavenly way,
No rain, be sure, will mar the summer day.

Cumulonimbus

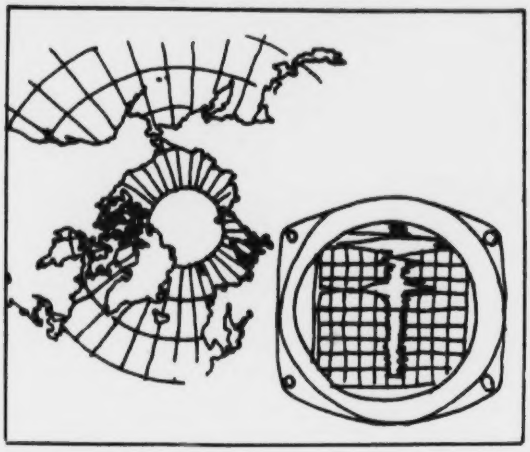
When the clouds appear like rocks and towers
The earth's refreshed by frequent shower ·
Or a sunshiny shower won't last half an hour.

6. Now distribute the worksheet Track that Storm! (Answers: Here it comes: 1. NE; 2. warm, cold; 3. 972 millibars, 980 millibars; 4. SE, 45 knots, heavy rain. There it goes: 1. About 600 nautical miles; 2. occluded, stationary; 3. 1032 millibars, 1018 millibars, 20 knots, partly clouded.)

7. Finish up this activity with a weather prediction contest. Have each student predict the weather for the next day!

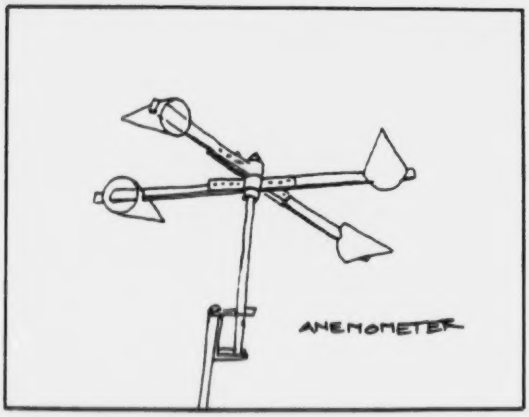

cirrus
cirrostratus
cirrocumulus
altostratus
altocumulus
stratus
stratocumulus
cumulonimbus
cumulus
nimbostratus
stratus

Activity 2
Measuring the Weather



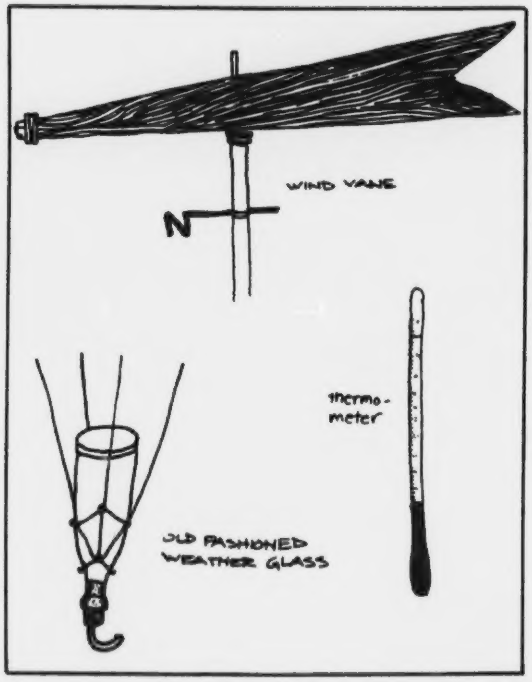
Background:

Six basic instruments are used by both professional and amateur meteorologists: 1) anemometer, 2) wind vane, 3) barometer, 4) thermometer, 5) rain gauge, and 6) hygrometer. The anemometer measures wind velocity. Weather bureaus often give wind speeds in knots (nautical miles per hour). In 1806, before the anemometer was invented, British Admiral Sir Francis Beaufort developed a scale of wind force based on the observations and descriptions of sailors. The wind vane indicates wind direction.

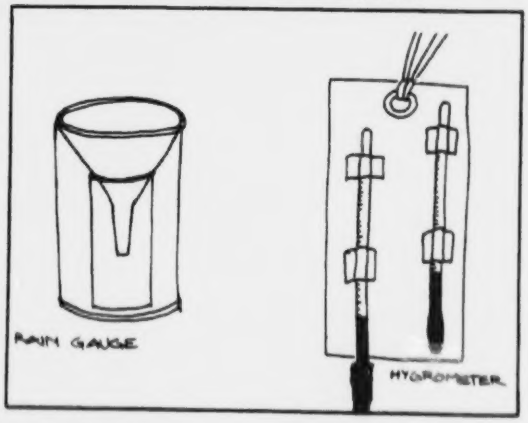


The barometer indicates air pressure. Old-fashioned weather glasses used water to indicate barometric pressure. Modern barometers are read in inches or centimeters of mercury. The average air pressure at sea level is about 30 inches. At higher altitudes, average air pressures are lower, so readings are corrected to sea level before comparing different places on a weather map. On U.S. weather maps, all pressures are converted from inches to millibars (1000 millibars = 29.53 inches of mercury on the barometer or about 18 pounds of air pressure). Falling air pressure generally indicates bad weather and rising air pressure signifies fair weather.

The thermometer measures air temperature. Mercury or colored alcohol are sealed in a glass tube with a bulb at the bottom. The liquid rises and falls with changes in air temperature.



Rain gauges measure the amount of precipitation. A typical gauge consists of a container to hold the rain, a funnel to slow down evaporation, and a small calibrated jar to measure the rainfall. Snow depth is often just measured with a ruler or meter stick, carefully choosing an area where the snow is not drifted or wind-blown.



Hygrometers measure humidity. The relative humidity is the ratio of the amount of water vapor that is present in the air to the amount of water vapor that could be in the air at that particular temperature. Two common types of hygrometers are wet- and dry-bulb hygrometers and hair hygrometers. The wet- and dry-bulb hygrometers utilize two thermometers--one whose bulb is kept wet, and another that is kept dry. The temperature difference between these two thermometers is read to determine humidity. If the difference is large, humidity is low; if the difference is small, humidity is high because the amount of cooling is directly dependent on the water vapor pressure in the air. The hair hygrometer works on the principle that human hair responds to the amount of humidity by stretching or shrinking. When humidity is high, the hair stretches, and it shrinks when humidity is low.

Vocabulary:

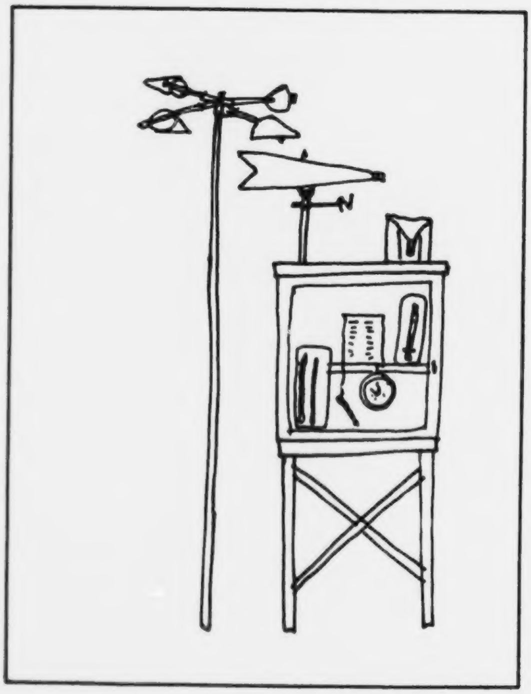
- anemometer
- wind vane
- barometer (review)
- rain gauge
- hygrometer
- calibrate
- precipitation

Materials:

- ¼" plywood
- large metal washers
- two broomsticks
- coat hanger wire
- pliers
- large headless nail
- screw
- drill
- wood dowels
- 4 paper cups
- heavy duty tape
- saw
- felt-tip markers
- pop bottle
- cork
- V-shaped glass tubing
- heavy string
- funnel
- large juice can
- glass jar with straight sides
- 3 thermometers
- shoe lace
- cardboard
- worksheets:
  ...Make Your Own Weather Instruments (6E)
  ...Keeping Watch on the Weather (6F)

Procedure:

1. Challenge students to make their own weather station. Pass out the worksheet Make Your Own Weather Instruments. Students and their parents might help you come up with the supplies. Plan a spot on the school grounds to put up your instruments (illus.).



2. Once the instruments are made, begin recording daily weather. Try to do it at the same time every day. Use the worksheet Keeping Watch on the Weather. Also, record the highlights of each day's weather on the school calendar, drawing pictures of sun, snow, wind or rain.

3. Graph your results. First graph each measurement individually. Then try graphing several together. Can the class infer any relationships between the different measurements? Has their weather forecasting ability improved?

4. Also have students figure weekly and monthly averages and the amount of change from one day to the next! What conclusions can they draw from their studies?

Activity 3
Acid Rain and Air Pollution

Background:

Many Alaskans seem to assume that because we live way off in the wilds, there is no problem with air pollution. Yet Fairbanks and Anchorage have some of the worst air pollution in the nation. In addition, Alaska is affected by industrial waste from other areas of the world. Oil- and coal-fired power plants, smelters, automobiles and other polluters in Japan, China, Siberia and Europe are all potential causes for acid rain in Alaska. In Bethel, preliminary precipitation and pond studies by students there have shown pH readings as high as 4 (quite acidic!)

What does all this have to do with weather? Scientists are worried that heavy industrialization and increased particulates in the air will change weather patterns. If the climate warmed up just a few degrees, the polar ice packs would begin to melt, flooding coastal cities.

If students all over Alaska began collecting data on particulates and precipitation, we might have a better idea of air pollution in Alaska and the potential for climatic variations. Because of vast distances, scientists have not been able to cover the whole state, so your students could make a welcome contribution to scientific knowledge! (Mike Stickick, Bethel Kilbuck Elementary suggested this activity.)

Vocabulary:

- acidity
- alkalinity
- pH scale
- particulates
- greenhouse effect

Materials:

- index cards
- new plastic bags (small)
- pH paper (range 2-5, 4-7 and 6-9)
- vaseline
- petri dishes (or blocks of wood or tile painted white)
- worksheet:
  ...Buy Bikinis... or Haul Out Your Parkas? (6G)

Procedure:

1. Ask students how they think weather is related to air pollution. Then pass out the worksheet Buy Bikinis... or Haul Out Your Parkas? (Answers: 1. carbon dioxide from burning wood and coal could create a "greenhouse effect"; particulates in the air could block out the sun and cool things off; 2. carbon dioxide; 3. (illus.); 4. permafrost would melt, less ice pack, less snow, more bare ground, increase in arctic shipping and fishing, summers cooler and wetter, farming increase, flooding of coastal areas; 5. 10,000 years; 6. the earth's axis could tilt away from the sun; 7a. violent storms of electrical gases; 7b. increase our temperature)

2. Have students check the community for air pollution. Particulates (small particles) are the easiest to see, but the least harmful of the air pollutants. Nonetheless, they will give students an idea of local air pollution. Students should prepare test samples by smearing vaseline on petri dishes (or white tiles or blocks of wood painted white so the particulates can be easily seen). Then set these samples out in various spots in the community where animals or young children cannot get into them. Check them 24 hours later. Label the sample locations and have the students design a way to compare them.

3. Have students check for acid rain or snow. Explain that the pH scale is an indicator of how acid or basic a substance is. The scale goes from 0-14. Low numbers are acidic and high numbers are basic. Seven is neutral. Have students test common substances with a high quality pH paper. The pH paper comes in a variety of ranges. So if you're using a pH paper with a range of 4-7, then for anything that comes out 4, you should also check on a larger range paper, i.e., 2-5. All rain is slightly acidic (pH 5.6) but industrial practices--for example, the burning of coal in factories or power plants--can make the precipitation highly acidic.

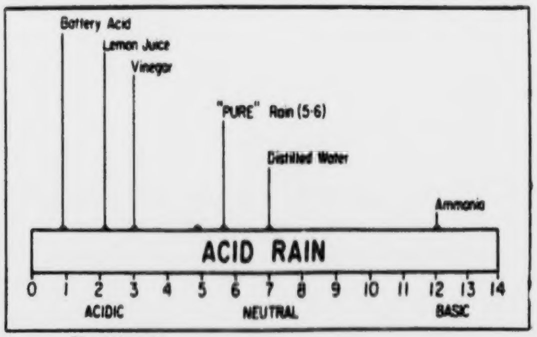
Burning coal releases SO_2 (sulfur dioxide) into the air, along with other waste products. When SO_2 combines with H_2O (water)--rain or snow--it forms H_2SO_4 (sulphuric acid).

$$SO_2 + H_2O \longrightarrow H_2SO_4$$

In a similar way, nitrogen oxides, which are principally generated from car exhausts, can form nitric and nitrous acids when combined with water. These acids can have grave consequences on fish, wildlife and vegetation, not to mention people. And these pollutants can travel thousands of miles with the air currents. Acidity also occurs naturally. Both volcanoes and thunderstorms release oxides into the air that can combine with the water molecules.

Ask students what would happen as a result of increased acid rain. (The fish in lakes and streams would die. Wildlife would be affected when they tried to drink the water. Vegetation might die. And here in Alaska, once the vegetation was gone, the permafrost would start to melt. In addition, many areas in Alaska, such as in the Interior, are keenly susceptible to acid rain and snow, as the soils don't have much natural "buffering" ability; i.e., the soils have not derived from limestone, which is basic).

To check for acid precipitation, give each student a new plastic bag and have them stand outside for 15 minutes in the rain or snow, holding the bags open. As a control, have some students pour a little bit of distilled water in a bag outdoors. Test the samples with pH paper immediately. Tape the paper on an index card and mark its reading and location and note the weather, including percentage of cloud cover (25, 50, 75 or 100), air temperature, and a general description. Try the experiment if possible during a thunderstorm, as University of Alaska scientists have found readings as low as 3.0 under storm conditions.



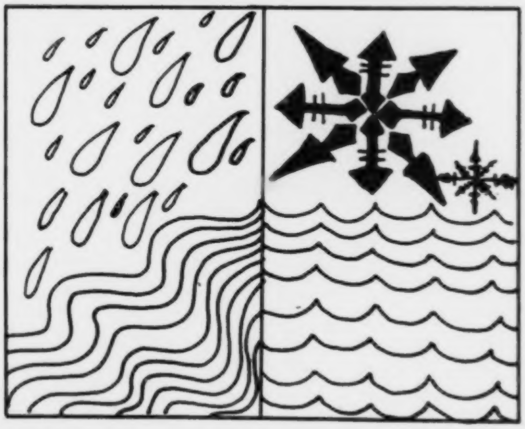
The pH scale.

The pH scale is also logarithmic, which means that a change of one unit on the scale means a ten-fold change in how acidic or alkaline a solution is. Battery acid at pH 1 is only one unit down the scale from lemon juice (pH 2), but is ten times more acidic. It is 100 times more acidic than vinegar, which has a pH value of 3.

Students might also want to test other local water spots, then mark the results of their study on a community map. Write up a class report of your results. Are there any sources of SO_2 (sulfur dioxide) in your community, such as coal power plants?

Are there places where old car or boat batteries are dumped that could be increasing acidity levels? Include this information. Discuss the results with area biologists and village officials. Send one copy to Acid Rain Project, Alaska Cooperative Fishery Research Unit, University of Alaska, Fairbanks 99701. Also send in a sample of your leftover, unused Ph paper to be tested for its buffering capacity. All those who send in reports will receive a yearly update on the progress of this statewide project. Be sure to send results of rain that's normal or basic, too! It's important to have all results to correctly gauge what's happening statewide.

Activity 4
Water in Your Community



Background:

Water comes in many forms--rain, snow, sleet, hail--and it remains as streams, rivers, lakes, marsh, muskegs and underground water supplies. Water may seem abundant, but only a limited amount exists. We will never have more water on earth than we have right now. The great majority of water on the planet is salt water. Fresh water is especially precious because we need it for life.

Fresh water can be changed to salt water at an overly fast rate through poor watershed management. As wetlands are filled in and covered over, rain washes downstream to salt water faster because there is no chance for water to soak into the ground. Floods and soil erosion are also more likely, and once fresh water reaches salt water, it only evaporates and changes back to fresh water through the hydrologic cycle at a set rate. Thus, we could ultimately end up with more salt water in proportion to fresh water.

Additionally, groundwater that is tapped for residential, agricultural and industrial uses replaces itself very slowly. Shallow groundwater may have a renewal rate of approximately 300 years; deep ground water (more than 3,000 feet) may renew itself in about 4,600 years. As groundwater dries up, ponds and marshes dry up and plant species die out. The remaining groundwater may also become contaminated by saltwater intrusion or by pollution, rendering it unfit to drink.

Most of the world's fresh water is used for irrigation, but personal water conservation can make a difference. In Alaska, it often seems as if we have more water than we could ever want. But even rainy coastal communities have been known to run low on water because collection and storage facilities are limited.

Vocabulary:

- hydrologic cycle
- ground water
- waste water treatment
- conservation
- precipitation
- evaporation
- condensation

Materials:

- chalkboard and chalk
- cups
- water
- graph paper
- pencils
- worksheet:
  ...Water and I (6H)

Procedure:

1. Give each student a cup of water. Tell them that one of their ancestors from Europe, Asia, Africa, or Alaska might have drunk this same water thousands of years ago. Ask students how this could happen.

2. Now begin drawing a picture of the hydrologic cycle on the board, with help from the class. All water ultimately comes from rain (or snow) in what is called "precipitation." This water accumulates in streams, rivers and lakes, or is stored in underground reservoirs or various wetlands before beginning its journey to the sea. The sun continually evaporates the water over land and sea, transporting it upwards where it eventually condenses and forms clouds ready to rain or snow again. The water that we have now is all we'll ever have. That's why our ancestors may have drunk the same water that we are drinking today. Of course, as it goes through the hydrologic cycle, it's filtered and purified. So drink up!

3. How much water do your students use every day? Pass out the worksheet Water and I. Discuss question 2 as a class. Let students come up with their own methods for measuring individual water use. Here are some figures that may help students with hard-to-measure items: toilet flushing, 5-7 gallons; showers, 5-15 gallons/minute; baths use 25-30 gallons; dishwater, 5 gallons/load; clothes washer, 25-30 gallons/load; bathroom faucet, 2-5 gallons/minute.

   Conservation is very important because we have all the fresh water we'll ever have. The sun can only evaporate water at a certain rate, and then return it as rain or snow at a certain rate. So if we use it up and send it down to the sea too fast, we will continually have less and less fresh water, and more and more salt water. Groundwater replenishes itself slowly, taking hundreds and even thousands of years. In addition, it takes energy to pump water out of the ground, and also takes lots of energy to heat water.

4. Graph individual results from the worksheet. Compare water use by students who have running water with those who don't. Imagine hauling the 70 gallons of water a day used by each member of the average American family!

5. Investigate your local water sources. Where does your community get its water? Are there any communities upriver or downriver that share your water? Does your community have a water treatment or sewage treatment plant? Students may want to visit these sites to learn more about local water quality and future plans for the community. Students may discover the need for a local water education program. Design one and carry it out.

Unit Seven
A Review of Sea Week's Past

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  Worksheet:
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Activity 2: Review Worksheets..120
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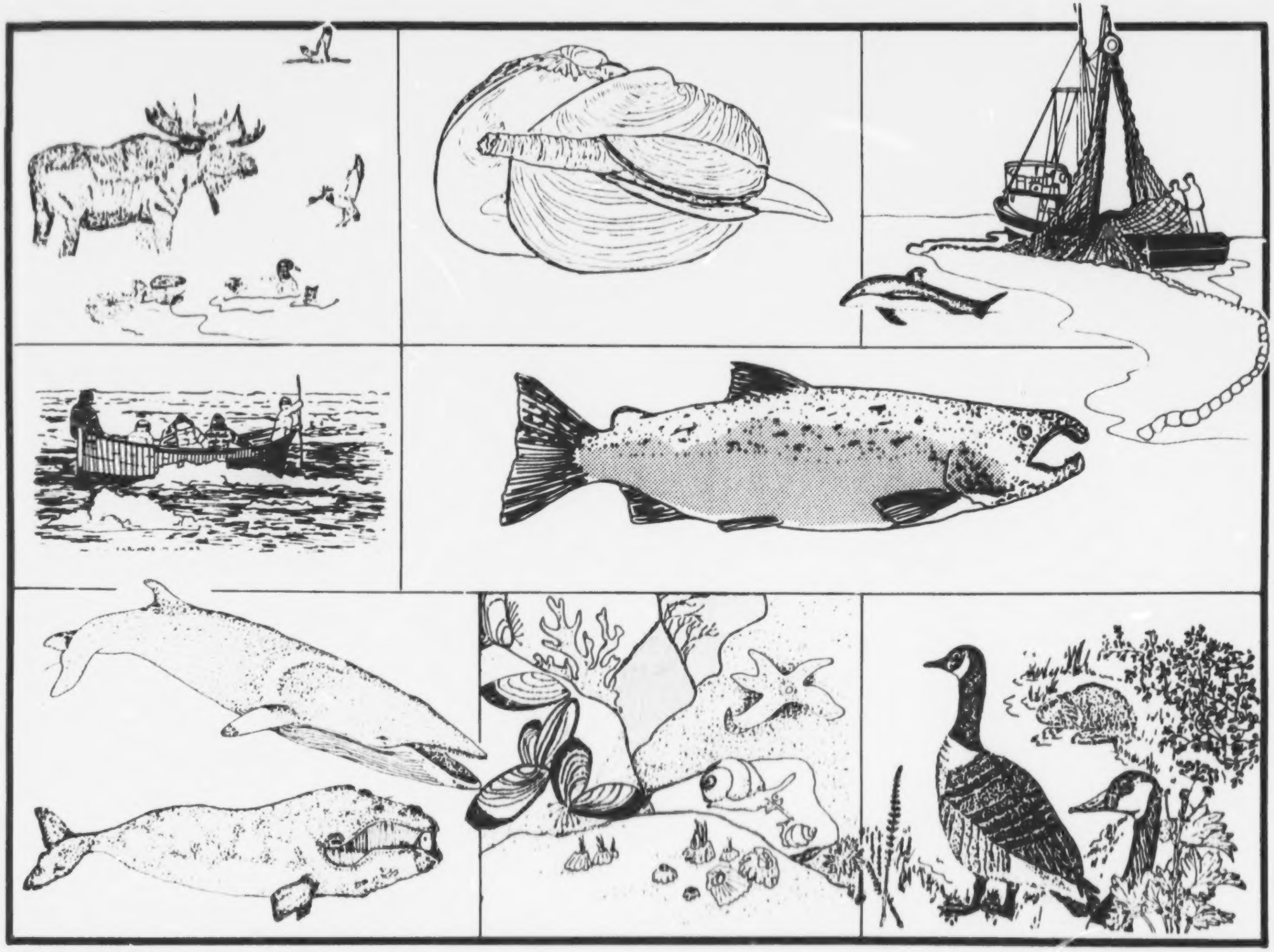
    Marine Invertebrates 7C
    Mollusks 7D
    Seaweeds 7E
    Intertidal Zonation 7F
    Freshwater Invertebrates · 7G
    Birds 7H
    Birds in the Field 7I
    Fish 7J
    Fisheries 7K
    Marine Mammals 7L
    Freshwater Mammals 7M
    Glaciers and Sea Ice 7N
    Native Uses of the Seas
      and Rivers 7O
    Safety and Survival 7P

Activity 3: Sharing What
  You Know 125

Objectives:

To help students:

- Set up learning centers on marine and freshwater topics (Activity 1).
- Complete worksheets on aquatic habitats, invertebrates, seaweed, intertidal zonation, birds, fish, fisheries, mammals, glaciers and sea ice, Native uses of the seas and rivers, and safety and survival (Activity 2).
- Design a Sea Week instructional session for one or more of the younger classes (Activity 3).

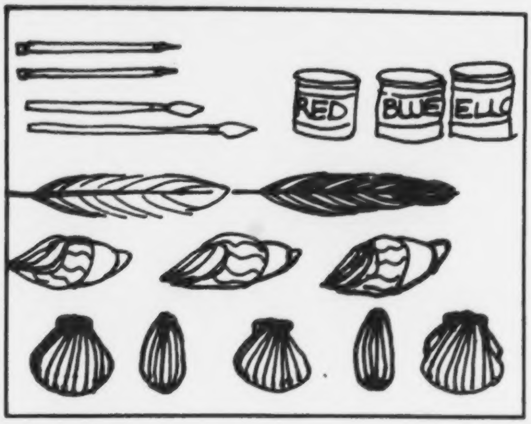


UNIT SEVEN: A Review of Sea Week's Past. From upper left clockwise--moose and ducks in a pond; clams; a fishing trawler and salmon; geese and a beaver in a marsh; starfish, snail, seaweed and barnacles on the shore; a right whale and a minke whale; and Eskimos in an umiak illustrate the diversity of subject matter that was covered in previous Sea Week volumes.

In the lower grades, students have had a chance to cover a wide variety of marine and freshwater subjects through Sea Week activities. This year, they have the opportunity to pull all that background information together, applying it to local issues.

One of the best ways to be sure that students really understand all they have learned is to have them instruct other people; hence, the activities in this unit turn your students into teachers!

Activity 1
Learning Centers



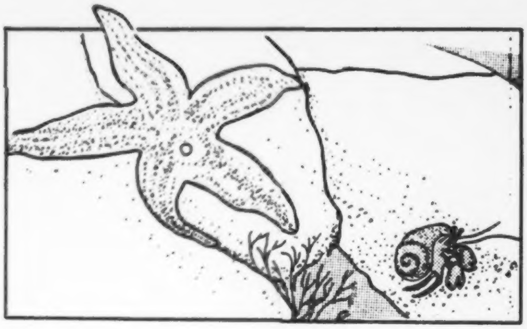
Materials:

- Sea Week curriculum guides (Volumes I-VII)
- props and artifacts
- pencils
- paper
- art supplies
- ditto machine or copier
- reference and children's books
- worksheet:
  ...Ocean Word Images (7A)

Procedure:

1. Explain to students that this is their chance to be teachers. Divide the class into small groups and assign them space to set up learning centers around the room. For each center, they should have:
   - a puzzle
   - a prop or artifact that other students can touch or use, such as net-mending needles, bones, shells, seaweed, bird feathers
   - a book to read
   - worksheet(s)

records, tapes, filmstrips, photos or pictures



Students may get their information from reference books, community residents, or the Sea Week Curriculum Guides. Here are suggested topics and where to find them in the guides:

Topics	Sea Week Curriculum Guides
Ocean	All volumes
Ponds, Streams and Rivers	All volumes
Wetlands	All volumes
Marine Invertebrates (except mollusks)	I, II, IV
Mollusks	I, III
Seaweed	I, IV
Freshwater Invertebrates	II, III
Birds	I, V
Fish and Fisheries	II, VI
Marine Mammals	I, II, IV, VII
Freshwater Mammals	II, IV
Glaciers and Sea Ice	IV
Native Uses of the Seas and Rivers	IV
Safety and Survival	All volumes

Smaller classes may want to combine several of these topics.

Challenge the class to be creative in figuring how to pass information they know on to the rest of the class. Remind students to ditto or copy puzzles and worksheets at their learning centers, so that each class member can have one. Encourage them to include math problems, vocabulary and spelling words in their centers, as well as to look for poems. For example, the following is one on shells:

SEE WHAT A LOVELY SHELL

See what a lovely shell.
Small and pure as a pearl,
Lying close to my foot,
Frail, but a work divine,
Made so fairily well
With delicate spire and whorl,
How exquisitely minute,
A miracle of design!

What is it? a learned man
Could give it a clumsy name.
Let him name it who can,
The beauty would be the same.

The tiny cell is forlorn,
Void of the little living will
That made it stir on the shore.
Did he stand at the diamond door
Of his house in a rainbow frill?
Did he push, when he was uncurl'd,
A golden foot or a fairy horn
Thro' his dim water-world?

Slight, to be crush'd with a tap
Of my finger-nail on the sand,
Small, but a work divine,
Frail, but a force to withstand,

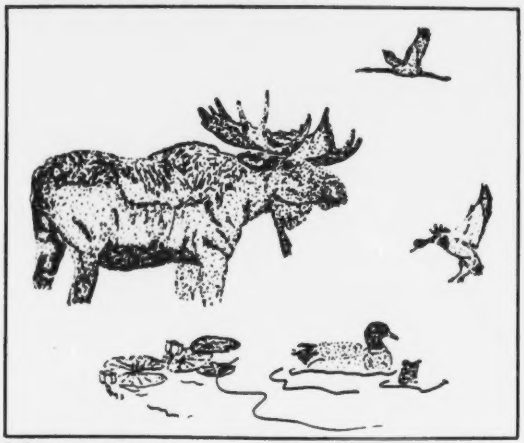
Year upon year, the shock
Of cataract seas that snap
The three-decker's oaken spine
Athwart the ledges of rock,
Here on the Breton stand!

--Alfred Lord Tennyson

2. Use the Ocean Word Images worksheet to get students started thinking about puzzles they can design. Ruth Berman, designer of these puzzles (with help from her students), is a long-time California marine educator. (Answers: 1. sea gull; 2. sand dollar; 3. octopus; 4. sea horse; 5. starfish; 6. plankton; 7. clam up; 8. school of fish; 9. surface; 10. man overboard; 11. tidal wave; 12. sea bed; 13. dolphin; 14, fish-eye view; 15. man-eating fish; 16. swordfish; 17. surface tension; 18. jellyfish.

3. Once the centers are complete, have each student go through all of them. Other classes or parents may want to tour and try out your learning centers, too! Think up a sea-going name for your collection of learning centers, and make badges or certificates for everyone who finishes.

Activity 2
Review Worksheets



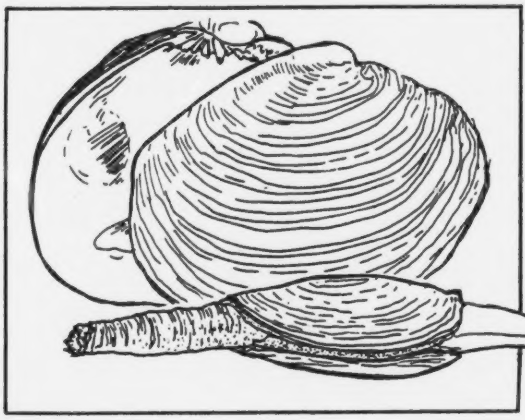
Materials:

- Sea Week curriculum guides
- reference books
- worksheets:
  - ...Aquatic Habitats (7B)
  - ...Marine Invertebrates (7C)
  - ...Mollusks (7D)
  - ...Seaweeds (7E)
  - ...Intertidal Zonation (7F)
  - ...Freshwater Invertebrates (7G)
  - ...Birds (7H)
  - ...Birds in the Field (7I)
  - ...Fish (7J)
  - ...Fisheries (7K)
  - ...Marine Mammals (7L)
  - ...Freshwater Mammals (7M)
  - ...Glaciers and Sea Ice (7N)
  - ...Native Uses of the Seas and Rivers (7O)
  - ...Safety and Survival (7P)

Procedure:

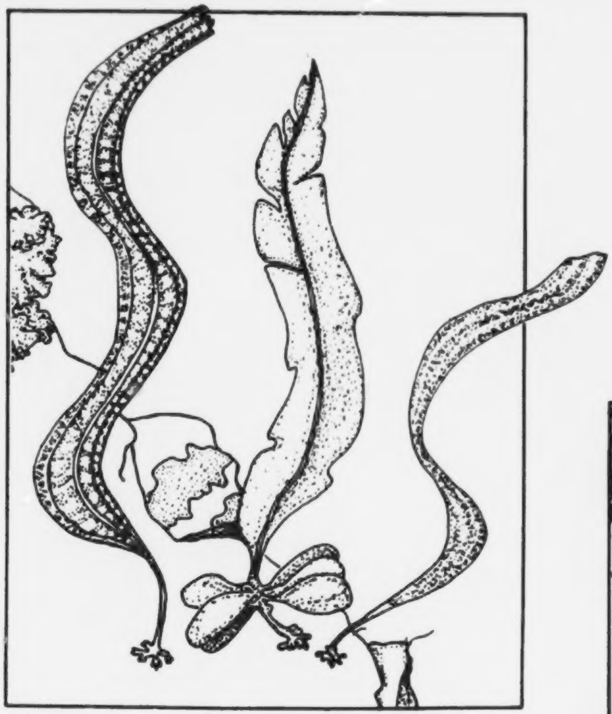
1. Pass out the worksheets. Encourage students to use the Sea Week curriculum guides and reference books to find the answers. The previous activity lists the location of these different topics in the Sea Week curriculum guides. In any case, here are the answers for your information:

Aquatic Habitats - magic number is 15; A. 7; B. 3; C. 5; D. 2; E. 4; F. 9; G. 6; H. 8; I. 1; 10. Seas, rivers and wetlands provide fish and wildlife habitat; human food; jobs; recreation; and are a source of beauty and inspiration. Oceans and rivers are especially important for transportation; wetlands are crucial for ground water recharge and flood control, and help also to buffer storms.



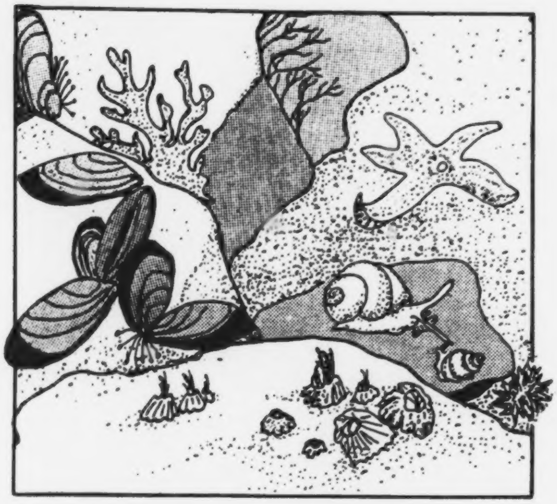
Marine Invertebrates - 1D, sea star; 2H, limpets; 3E, barnacles; 4G, sea anemone; 5A, mussels; 6C, sea urchin; 7I, snail; 8F, sea cucumber; 9B, razor clam; 10J, octopus.

Mollusks - mollusks, mollusks; 1a. univalves; 1b&c. limpets, snails; 1d. snails; 1e. limpets; 2a. univalves; 2b. bivalves; 2c&d. clams, cockles; 2e. foot; 2f. siphons; 3a. chitons; 3b. chitons; 4a&b. octopi and squid; 4c. octopi; 4d. squid; 4e. mollusks



Seaweeds - 1. green, brown, red; 2. algae; 3a. blade; 3b. float; 3c. stipe; 3d. holdfast; 3e. flower; 3f. stem; 3g. leaf; 3h. root; 4. look similar, have chlorophyll to make food, are usually stationary. Some seaweeds in warmer climates float--but they don't locomote; 5. are flexible and cannot remain vertical if they are not supported by water; they lack flowers; their blades are comparable to leaves, but are sometimes found at the top rather than along the sides or bottom; the holdfast functions primarily for hanging on, rather than supplying nutrients as roots do; seaweeds sometimes have floats; seaweeds live in salt water; 6. spring and summer because conditions are most favorable for growing then, with plenty of light and warmth

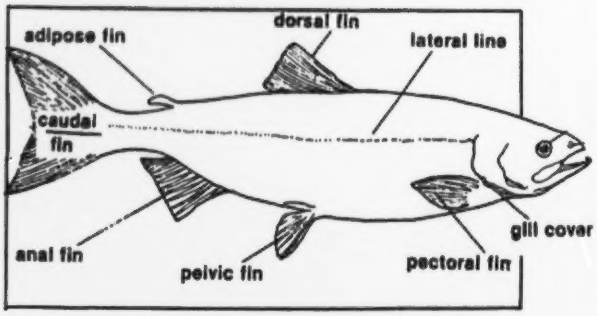
Intertidal Zonation - 1a-e. exposure to air, summertime warmth and dryness, wintertime freezing temperatures, predators from the land and sea, hanging on in surf and storms; 2a-b. black lichen, blue-green algae, periwinkle; 3a-f. Fucus, mussels, barnacles, amphipods, sea stars, cucumbers; 4a-e. sea stars, anemones, juvenile king crabs, larger snails, sea urchins



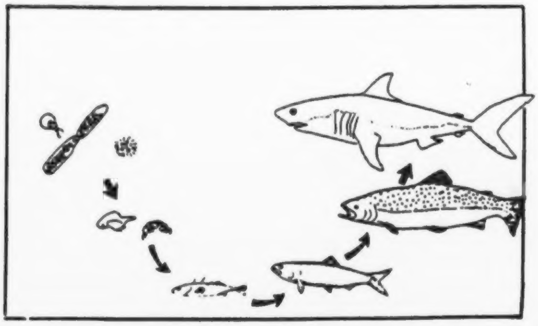
Freshwater Invertebrates - many possible answers

Birds - 1-6. swimming birds; waders; birds of prey; gull-like birds; grouse and ptarmigan; perching birds; 7. the abundance of food, cover, water, open space and in general the lack of human disturbance; 8. pollution might harm or kill birds by oiling their feathers or causing disease; overhunting might lower bird populations; increased human activity might change patterns of distribution, but the greatest threat is loss of habitat through building, dumping and filling on wetlands.

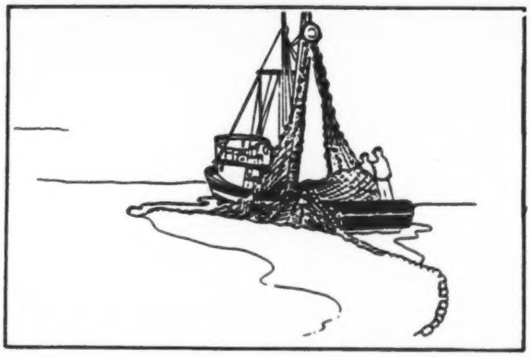
Birds in the Field - a. Canada goose; b. pintail duck; c. bald eagle; d. red-breasted merganser; e. tundra swan (whistling); f. black-legged kittiwake; g. semipalmated plover; h. great horned owl; i. black oystercatcher; j. mallard; k. oldsquaw; l. great blue heron; m. bufflehead; n. tufted puffin; o. snipe; p. Arctic tern; q. surf scoter; r. willow ptarmigan; s. raven; t. common eider

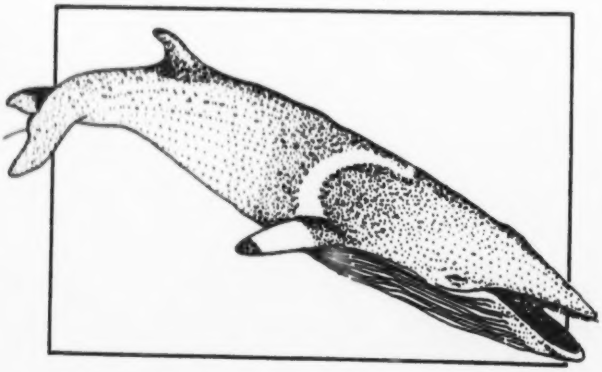


Fish - 1. (illus above); 2. chum or dog; silver or coho; king or chinook; red or sockeye; pink or humpy; 3. egg, alevin, fry, smolt, adult salmon; 4. Wetlands are important salmon spawning and rearing habitat. The wetlands soak up rainwater and snow melt and release it gradually, assuring even flow. Additionally, insects and debris along streambanks and edges of ponds supply food for young salmon. Wetland plants supply nutrients that filter into the water system. Estuary wetlands at the mouths of rivers and streams are important rearing areas for salmon. Plankton and wetland plants grow extremely well due to the mixing of shallow, warm salt water and fresh water with additional nutrients washed down through the stream and river system; 5. many possible answers; 6. because they can hide so well; 7a-d. changing colors to fit their background, blending in with the bottom because they are flat and dark on top, blending in with the water's surface because they are white below, burying themselves in the sand; 8. (illus below)

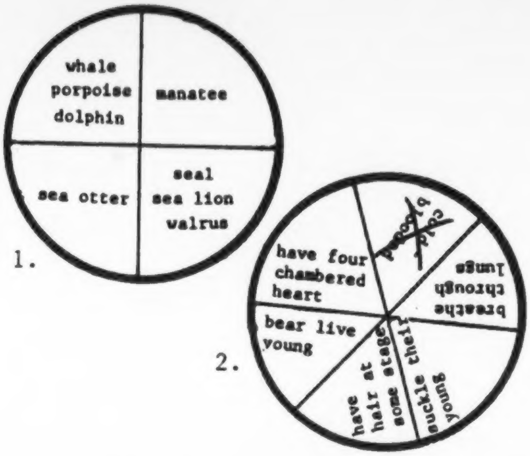


Fisheries - 1a-c. jigging, hook and line, spearing whitefish, trapping blackfish, trapping salmon (Annette Island); 2a. crabbing, Dungeness crab; 2b. trolling, salmon (kings and cohos); 2c. set gillnetting, salmon; 2d. purse seining, salmon (mainly pinks) or herring; 2e. longlining, halibut; 2f. drift gillnetting--salmon or herring; 3a-e. protect wetland spawning and rearing habitat and productive coastal waters, avoid pollution and overfishing through education and regulations.



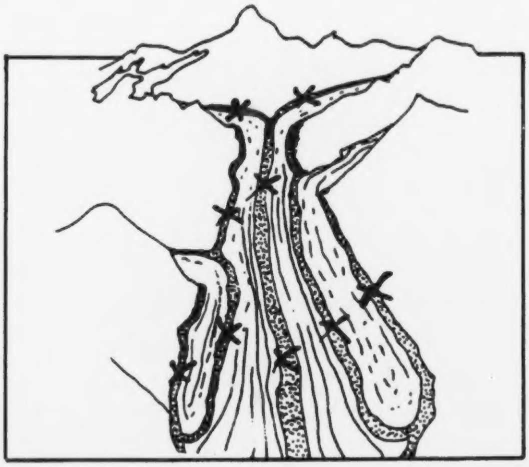


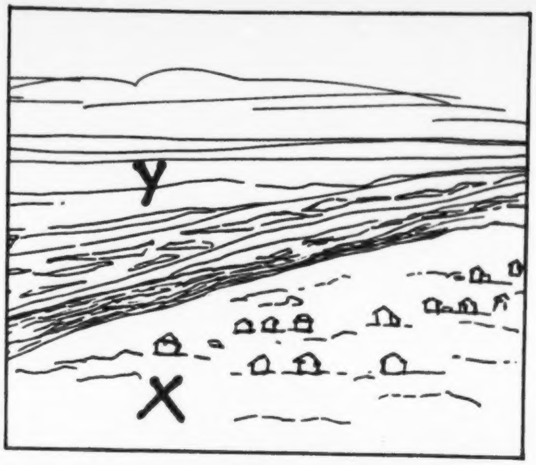
Marine Mammals - 1. (see illus.); 2. (see illus.); 3. true; 4. true; 5. false; 6. false; 7. false; 8. false; 9. false; 10. false; 11, 12. be able to swim, develop denser body hairs or a fat layer, adapt to marine foods; 13. echolocation is the interpretation of self-produced sound waves bouncing off objects on the ocean floor. It is used to spot fish and other prey and to gauge distance and direction. 14. Many possible answers.


1.
whale
porpoise
dolphin
manatee
sea otter
seal
sea lion
walrus
2.
have four chambered heart
~~cold blooded~~
breathe through lungs
bear live young
have hair at some stage
suckle their young

Freshwater Mammals - The following are the four groups: a(beaver track), b(beaver-chewed stump), i(beaver lodge), k(beaver); c(muskrat, d(muskrat house), j(muskrat track); e(river otter), h(river otter slide and tracks), l(river otter track); f(mink track), g(mink)

Glaciers and Sea Ice - 1. ice; 2. snow; 3. rocks; 4. silt; 5. motion; 6. leads; 7. black; 8. gray; 9. blue; 10. glacier carved, u-shaped valley, such as the one on the right; 11. (illus. below);

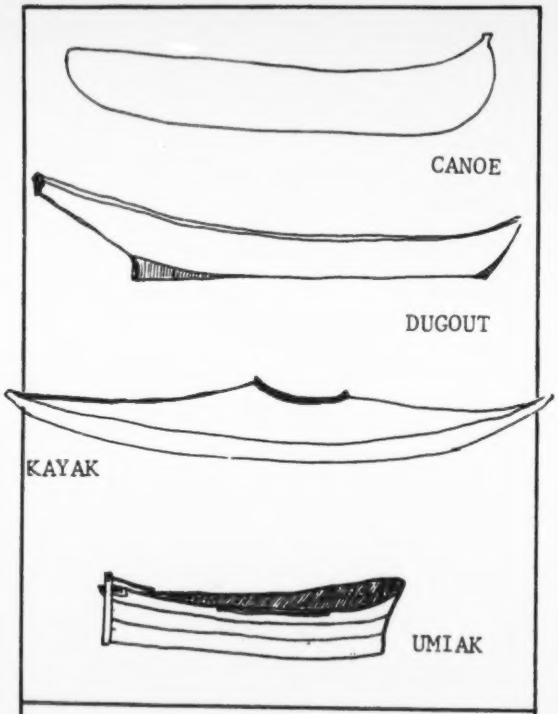


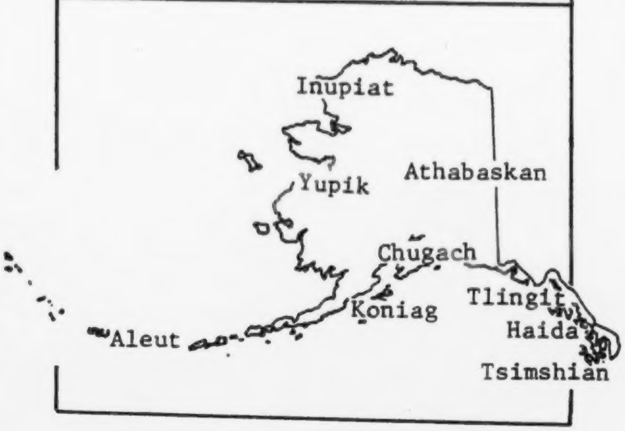


12. (see illus.); 13. onshore; 14. abundant; 15. flexible; 16. Glacial ice and sea ice are similar in that both are types of ice; both are constantly moving and dangerous; both glacial ice and old sea ice are brittle and blue and melt to form fresh water. They are different in that sea ice floats over a large body of water while glaciers move over land and have rivers running over them; glaciers form from snow, and sea ice forms from freezing salt water; young sea ice is flexible and salty; glaciers grind rocks up into glacial flour; glaciers change land formations.

glaciers grind up rocks into glacial flour; glaciers change land formations.

Native Uses of the Seas and Rivers - 1. (see illus.); 10a. dugout used in southeast Alaska; 10. umiak used in northern and northwestern Alaska; 11. kayak used in northern, western and south-central coastal Alaska; 12. canoe used in central or interior Alaska





Safety and Survival - 1a. PFD (life jacket or survival suit); 1b. life ring and line; 1c. anchor and line; 1d. survival kit, which includes lighters, sleeping bag, foam pad, tarp, line, hook and line, snare, tape, heavy cord, knife, water, and food (see Unit Eight, Activity 4);

1e. bailer; 1f. compass; 1g. motor with gas tank and line and spare motor, prop, tools; 1h. light; 1i. oars; 1j. first aid kit; 1k. sailing plans, i.e., tell someone where you're going and when you're coming back; 2. students should mention sending one person for help and beginning artificial respiration immediately! They should describe artificial respiration in detail; 3. events should approximately follow this order (discuss as a class) - h, i, f, k, j, c, a, b, n, g, l, d, m, e; 4. refer to Unit 8, Activity 4. Pick items from coffee can survival kit (Unit 8, Activity 4) that could be carried in your pocket, and discuss as a class. Should definitely include knife and lighter.

2. Discuss the worksheets as a class. You may want to do additional review on subjects with which students have the most difficulty.

Activity 3
Sharing What You Know

Materials:

- paper
- pencils

Procedure:

1. Ask students if they would like to design a Sea Week program for younger students. Explain that the best way to tell if you really understand something is to try to teach someone else. Brainstorm some different options. First you will have to figure out who your audience will be and what will appeal to them, and then decide on a topic or topics. Your class could:

    - give short talks to the younger children
    - take the younger children on a field trip
    - present a play or skit
    - read stories
    - show slides or films
    - help the younger children make something such as little boats, puppets, or mobiles
    - cook seafood for them to taste

- make up games or puzzles
- set up exhibits

2. Now have students write outlines of what they want to say, and prepare any necessary displays or props.

3. Discuss teaching techniques and have students practice with each other. Ask students when they have learned the most, and ask them to discuss the qualities of their favorite teachers. Be sure to mention that if students ask the younger children questions instead of telling them everything, the children will have to think a little more and will also remember more. If asked questions by the younger children that they can't answer, students should say that they don't know, but will be glad to look up the answers.

4. Remind students to be gentle with the younger ones, as well as to set an example of good behavior.

Unit Eight
Sea Week Camp

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Activity 2: Scientific Sampling 135

Activity 3: Safety and First Aid 141

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  Water Safety Cartoons..8B

Activity 4: Survival 144

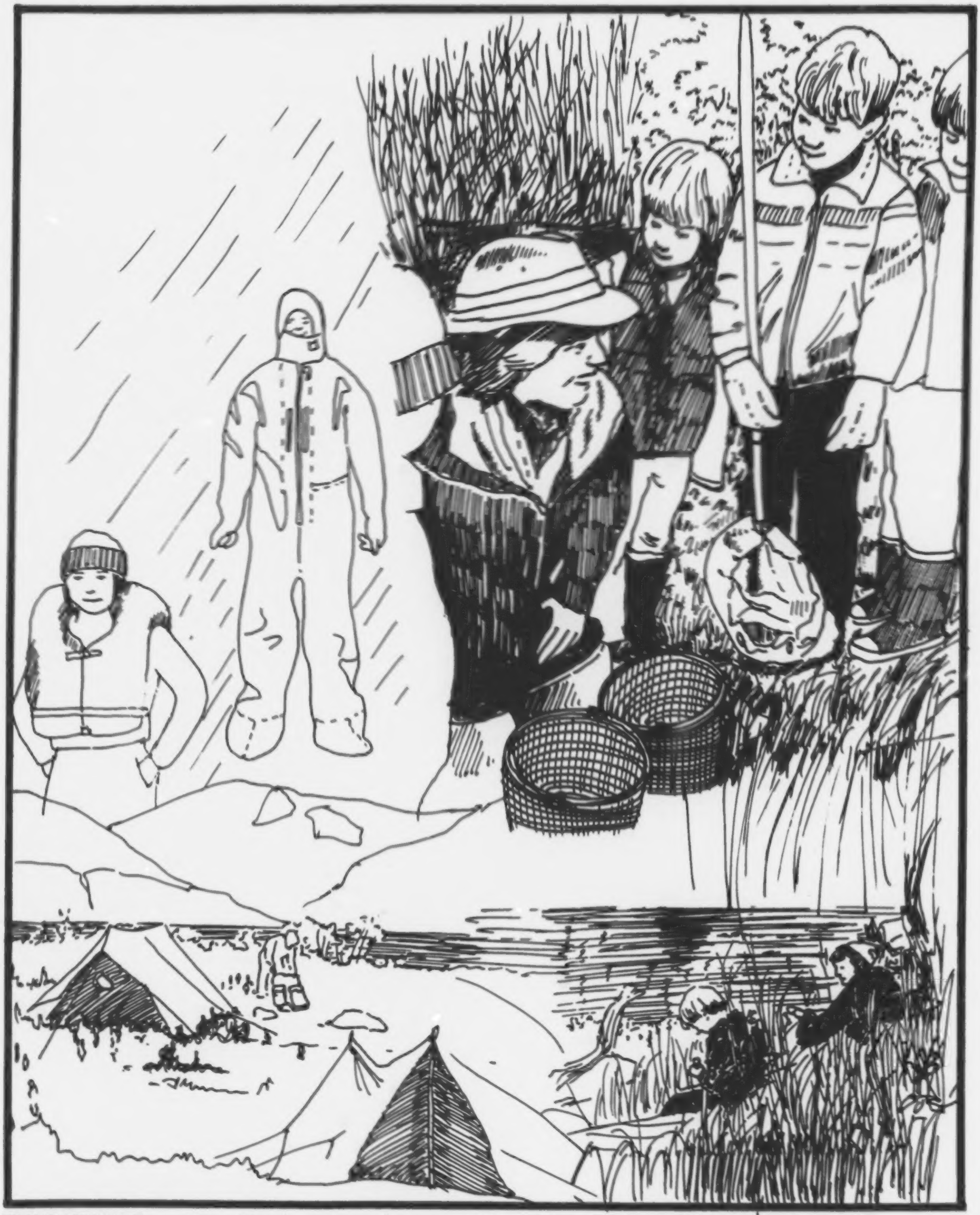
Worksheets:
  How to Survive On a Beach.................8C
  Survival Puzzle 8D
  Beachcombing Trip 8E

Activity 5: The Camp's Future.145

Objectives:

To help students:

- Plan food and gear for an educational experience outdoors (Activity 1).
- Measure plant and animal life on sample plots within a study area (Activity 2).
- Chart and graph these measurements (Activity 2).
- Estimate total numbers of plants and animals in the study area (Activity 2).
- Compute and graph research on the importance of wearing a PFD (personal flotation device) (Activity 3).
- Draw cartoons about water safety (Activity 3).
- Practice first aid (Activity 3).
- Learn to treat earthquake victims by staging a mock disaster (Activity 3).
- Read about beach survival (Activity 4).
- Make coffee can and pocket survival kits (Activity 4).
- Write survival guides for their own community (Activity 4).
- Participate in a simulation game about future development on their camping site (Activity 5).



UNIT EIGHT: Sea Week Camp is usually the highlight of the Sea Week experience. Pictured above are a tent camp and students wearing flotation devices, capturing pond creatures, and examining objects on the seashore.

A three to five-day Sea Week camp can easily be the highlight of a student's school year or entire school career! Each community has exciting places to explore, and the opportunity for learning and living with classmates, teachers, parents and community resource people is a never-to-be-forgotten experience. Students often make tremendous strides socially as they work and play together as a team at Sea Week camp.

Activity 1
Planning Your Camp

Background:

Sea Week camp can be as elaborate or as simple as you want to make it. Involving students and community resource people (including parents) in the planning and implementation will add to the camp's success. But be careful, as too many group decisions can be difficult for everyone.

The most important item to plan for is safety. Make sure all participants are warmly dressed, are wearing PFD's (life jackets), and know what to do if someone becomes separated from the group.

Have good food and plenty of it. Quality food really helps the morale and is important for growing youngsters. Students can make it through a lot of poor weather conditions as long as they have enough good food to eat and are dressed properly for the weather. Don't let a little rain or snow stop you!

"The only problem we ever had was when the kids had too much 'free' time," explains veteran schoolteacher Kay Pearson of Ketchikan, who has been taking students outdoors for years.

So make sure there is plenty for students to do: classes, arts and crafts, organized games, chores.

Have your program well-planned, but be flexible, too. If the hooligan or salmon are running unexpectedly, make that a learning opportunity. If the boat to pick you up is late, sing songs or play games to build students' sense of community. Sea Week camp can demonstrate that learning is fun for everyone. It can be the start of an enjoyable lifetime adventure for parents, students and teachers alike.

Materials:

- food
- cooking utensils
- resource people (including parents)
- shelter
- transportation
- field guides
- safety and survival gear

Procedure:

1. Obtain administrative approval. You may want to prepare a special presentation outlining your educational goals and objectives, safety considerations, resource people, lodging and transportation possibilities.

2. Organize a group of parents and other resource people to help plan the program and assist with logistics. Perhaps each person can figure out one aspect of the trip and report back to you. It is amazing the number of talented people in every Alaska community! (Refer back to the human resources list in your Community Inventory, Unit One, Activity 1.)

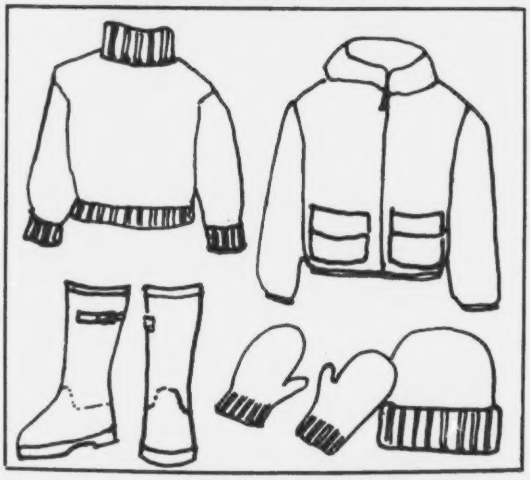
3. Decide on a location. Do you have access to a hunting camp or lodge where students can dry out their gear if necessary? Are there some small buildings where they can lay out their sleeping bags? Do some parents have tents that can be borrowed? What place has the most exciting habitat to explore? (beach? river? wetland?) Are there community events that students could be involved in? (muskrat or duck hunting? whaling? salmon or herring fishing? the spring bird migration? low tide exploration? fish camp?)

4. Work on transportation. Are there state or federal agencies close by? (U.S. Coast Guard? Forest Service? Fish and Game? Fish and Wildlife Protection?) Are there local charter operations that might be able to take students to the camp? Sometimes agency insurance will cover the students, particularly if students are signed up as volunteers to do an onsite project or survey. Would parents provide transportation if the school paid for the fuel?

5. Safety. Radio contact is important. Students need to review first aid procedures. Pack one or more first aid kits. Have students make survival kits. Discuss what to do if someone gets lost. If possible, every student should wear a whistle at all times. Life jackets should be worn during boat travel. Bear protection should be considered. Spare motors, tool kits, parts and oars

should be included if you're traveling by small boat. Sleeping bags, warm clothes, food and tarps should be spread out among all the boats (or other transportation), so that if anything happens to one boat, students will have adequate survival gear.

6. Students can help with planning the food. Stress good nutrition. You may want to have parents do the cooking, so that students can attend all classes. Have students wash their own individual dishes and assign a K.P. (kitchen patrol) crew to do the pots and pans. Plan for lots of food at mealtimes and nutritious snacks (apple slices, stuffed celery, dried fish, peanut butter and crackers) mid-morning, mid-afternoon, and at bedtime. Take extra dried food in case you are weathered in.



7. Warm clothing and rain gear are critical. The program should go on even in rain or snow. Students should have rubber boots or mukluks and several changes of clothes. Stress the importance of wearing wool clothes, dressing in layers and bringing warm hats. You may want to have all participants bring their bag of clothes (wrapped in plastic garbage sacks to keep them dry) the week before, so you can check everything over.

8. Each school has different policies for raising money. Will the school cover camp costs, or will students need to raise money with bake sales and carnivals? If each parent is asked to contribute, perhaps a scholarship fund can be set up to cover those who cannot afford it.

9. Students should be well prepared scholastically, by going over some of the previous units in this book. Be sure they cover some of the topics from earlier Sea Week volumes (see Unit Seven this volume). You might want to involve students in planning special educational games or puzzles for camp. Have them review safety and first aid (Activity 3 of this unit) and make up survival kits (Activity 4 in this unit). They should start journals if they haven't already (Unit 1, Activity 2). If the trip will be physically difficult, you may want to give tests of skill and/or required miles to cover ahead of time. It might be good to have students write down individual explanations of what they expect to learn as a result of their camping experience.

10. Below is a sample program for a three-day campon the coast. As long as you are planning for one night, you might as well go for two, as it usually takes some time for students to get used to everything. Three days is a good length of time for the first year, and the following years you can expand to as many as five days.

The actual travel to the camp area can incorporate the educational treasure hunt "I Spy," or a map-reading exercise, to set the proper learning atmosphere. Your program should depend on the resource people that you can bring along, as well as on your local history and culture. Start brainstorming on who is available in your community.

SAMPLE SEA WEEK CAMP PROGRAM

Monday

8:00-10:00	*Travel (treasure hunt on way)*
10:00-11:00	*Settling in/snack*
11:00-12:00	*EARTHQUAKE (first aid simulation game, see Activity 2 this unit)*
12:00- 1:00	*Lunch*
1:00- 3:30	*Classes - divide into groups*
	Birds and Wetlands (pond field trip): Group 1
	Fish and Fisheries (stream survey field trip): Group 2
	Marine Mammals (beach walk, creative writing): Group 3
3:30- 4:30	*Snack/beach games*
4:00- 5:30	*Classes - divide into groups*
	Net Crafts (making belts with knots): Groups 1 & 2
	Beach Collage (making plaques or mobiles): Group 3
5:30- 6:30	*Dinner*
7:00- 8:00	*LOCAL HISTORY (lecture/map work)*
8:00- 9:00	*Sing-a-long and snack*
9:00-10:00	*ASTRONOMY*

Tuesday

7:00- 8:00	*Breakfast*
8:00- 9:15	*INTERTIDAL LIFE EXPLORATION - low tide*
9:15- 9:30	*Snack*
9:30-12:00	*Classes - divide into groups*
	Marine Mammals (beach walk, creative writing): Group 1
	Birds and Wetlands (pond life field trip): Group 2
	Fish and Fisheries (stream survey field trip): Group 3
12:00- 1:00	*Lunch*

1:00- 3:30	*Classes - divide into groups* *Fish and Fisheries (stream survey field trip): Group 1* *Marine Mammals (beach walk, creative writing): Group 2* *Birds and Wetlands (pond life field trip): Group 3*
3:30- 4:30	*Snack/beach challenge course*
4:30- 5:30	*Classes - divide into groups* *Beach Collage (making plaques or mobiles): Groups 1 & 2* *Net Crafts (making belts with knots): Group 3*
5:30- 6:30	*Dinner*
7:00- 8:30	*Sea skits (students make up and then present)*
8:30-10:00	*Sing-a-long and snack*

Wednesday

7:00- 8:00	*Breakfast*
8:00- 9:15	*INTERTIDAL SAMPLING (low tide, see Activity 2 this unit)*
9:15- 9:30	*Snack*
9:30-12:00	*Classes - divide into groups with each group doing a similar study* *Coastal Habitat (habitat mapping, forest study, field trip)*
12:00- 1:00	*Lunch*
1:00- 3:00	*COASTAL PLANNING SIMULATION GAME (students debate what should happen to their camping site, see Activity 5 this unit)*
3:00- 5:00	*Snack/travel/sing-a-long - evaluation*

Units in this Sea Week volume or the previous volumes may be best covered or reviewed in a field setting such as your camp. For instance, ideas for fish and fisheries and netcraft can be found in Volume VI; birds and wetlands Volume V; marine mammals this volume. Weather (this volume) might be another good addition to your program. Coastal habitat can be explored and mapped. If you have trees in your area, check the logging, fisheries and wildlife unit in this volume for ideas.

The school's physical education instructor may be able to help design beach games and a beach challenge course that fits in with the educational theme; i.e., crab, octopus, seal walk relays; running down a whale's throat (through a cardboard box); swinging over a salmon stream (on a rope); riding a porpoise (on a swing); climbing up into a life raft.

The art instructor or a local artist may be able to help in planning art projects such as beach collages or mobiles.

For astronomy and local history, you'll need to rely on local resources.

Sea and river songs are included in the various Sea Week volumes and in the Sea Week Sourcebook.

Try to break students up in smaller groups whenever possible, so that everyone has a chance to see and talk with the resource people. Involve students in measuring and recording data and writing a class report on their results. Activity 2 of this unit explains how to do the intertidal transect mentioned in the sample program.

11. Have students develop rules for their camp (including safety procedures). Ideally, the rules will be easier to obey if students participate in making them up! Be sure to stress conservation.

12. Emphasize that this is an educational venture. It's also a chance for everyone to live, learn and work together. Have everyone draw names for secret pals--someone they will do something nice for every day.

13. Have a training session for parents and other participating resource people. Explain the program, giving them tips for working with students in this age group, and if possible, visit a site similar to where you will be camping. Go over field trip leadership techniques and answer questions.

Consider using older students for counselors and small-group leaders. They will probably get more out of the trip than anyone else. It's a tremendous learning experience for them to be looked up to, not only as models of good behavior, but as an educational resource.

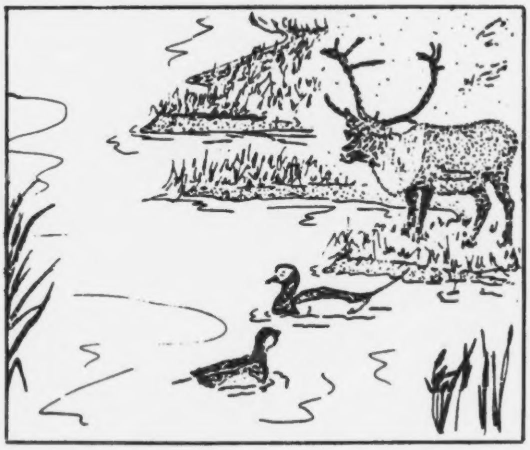
14. Alert local media (radio, tv, newspapers) about your trip. Be sure to take a camera and plenty of film to record happenings. A slide show would be a great memento for this year's students, as well as a good introduction for next year's students, teachers, parents and resource people.

15. When the great day arrives to leave for camp, be rested so that you can also enjoy the adventure and excitement.

16. Plan to take full advantage of the Sea Week camp after it's over. Have students: write stories and reports on their adventures; research some of their finds; compute trip costs; make thank you gifts for those who helped; create great works of art inspired by Sea Week camp experiences.

17. Plan a parents night to show slides, journals, charts, art projects, songs, gifts.

Activity 2
Scientific Sampling



Background:

Do you ever wonder when you hear a large figure such as the total of ducks in North America, trees in the National Forest, or people who watch a certain television program, how such high numbers can possibly be counted?

Often this is accomplished by a process called sampling--taking an exact count in a small area and then multiplying to obtain an estimate for the total area.

Biological sampling is sometimes done by taking counts in randomly selected plots. Coat hangers pulled into squares are a good device for marking plot boundaries. Counts are taken inside the plots and then used to estimate the number of small animals per acre on a rocky beach, the number of flowers or berries on an acre of tundra, etc. This method will work for anything that is fairly evenly distributed over a large area, and small enough to be found inside coat hanger plots.

Sampling is very useful for gauging changes taking place over a period of time. One may wish to measure changes resulting from natural causes: earthquakes, storm surges, shifting currents, the seasons, etc. Cycles of succession--lakes that eventually fill in to become marshes and later dry land, or meadows that gradually turn into forests--can be best understood by studying changes in animal and plant life over a period of many years.

Or one may study changes caused by human activities: the construction of a boat harbor or subdivision; the building of a road or pipeline; a dredging operation, or an oil spill. Scientists are sometimes asked to investigate an area and develop baseline data before a construction project takes place. If the proposed changes are on a large scale, environmental impact statements are required. To determine the actual effects of the development, data must also be collected during and after completion of the project.

This activity describes random plot sampling and systematic sampling using transects. Your students can use either one or both of these methods to monitor local changes. Standardize your sampling techniques as much as possible, so that classes year after year can collect and compare data. Sample not only your Sea Week camping spot but also a local development site.

Discuss planned development projects with city planners or members of the village council. Ask their advice on what area to study and also on what types of information it would be most helpful to them for your class to study. The data your class collects may be of real use in the future, so be sure to save your field notes and the report summarizing your findings. (This activity was developed with the aid of Jim and Mary Lou King, Juneau.)

Vocabulary:

- sampling
- random plot
- transect

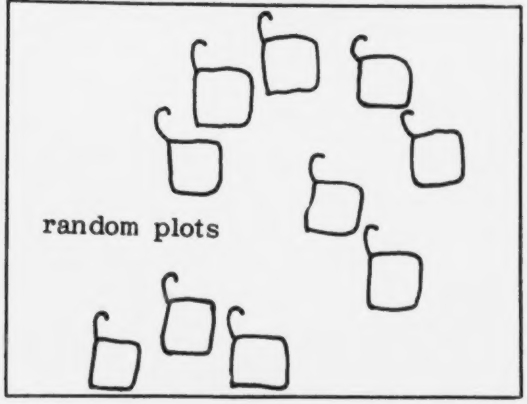
Materials:

- one coat hanger for every two students
- yardstick
- 100 ft lengths of ¼ in. rope or heavy twine (for the transect method)
- wooden stakes
- felt-tip markers
- hammer (or rock)
- adhesive tape
- small rulers
- paper
- pencils
- string
- pocket notebook for each student
- clipboard
- field identification guides
- camera and film (optional)

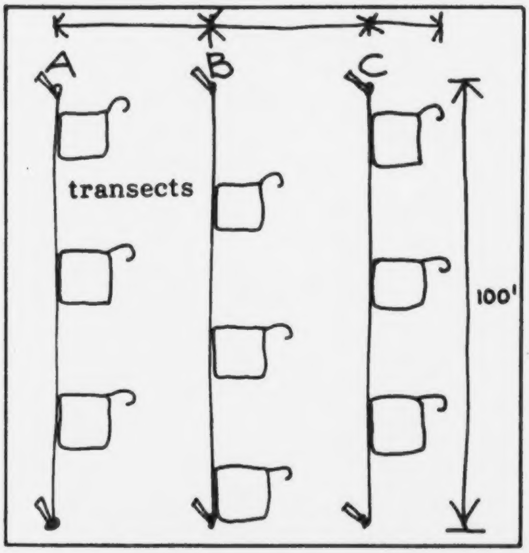
Procedure:

1. Decide on a study site. Ask students to describe how they would find out about the plants and animals living at this site. Plan to try out some of their suggested methods. Then explain the following two sampling techniques. Both require a supply of frames; these can be of any size, so long as the same size is used consistently in any one study. Coat hangers pulled into squares make handy plot frames, but wood or metal frames can also be used.

Random Plot Sampling: Explain that to make their plots random, each pair of students should stand along an edge of the site, close their eyes and throw their coat hanger inside. After counting and recording all the plants and animals inside the frame, they should close their eyes and throw again, proceeding in the general direction of the opposite side of the study site. Each pair should complete 5-10 plots (whatever is agreed on beforehand).



Systematic Sampling using transects: To make transect lines, stake 100 ft ropes (use nylon-cotton will stretch) across the study site. The ropes should be numbered consecutively and marked off ahead of time with adhesive tape every three feet or at some other regular interval. If your study site has a variety of habitat types (including, for example, tundra, marsh and lake) your transect lines should be laid out to cross all of them. Teams of two students each, using the coat hangers, should take sample measurements along the transect line at the taped intervals.



2. For both types of sampling, at least two of the study site corners should be marked with stakes or by some other means. If transect lines are used, these also should be marked, so that the study can be duplicated in the future.

3. Each team of two students should record its findings in a small pocket notebook. (Notebooks can be made by cutting sheets of scrap paper in quarters, then stapling them together. Punch a hole in one corner and tie a pencil to it with a string.) Students should head their notes with the date, time, location and weather. While sampling, one student of a pair can count while the other records. A separate page of the notebooks should be used for each plot.

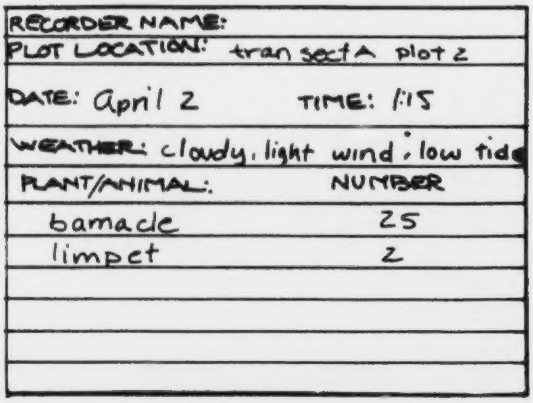
Have students write down the names of all species of plants and animals inside or at least more than halfway inside their square.

If students cannot identify something, ask them to draw a picture or write a description of it.

Students should make as accurate a count as possible of each species within the square. If there are too many to count, they can estimate by counting the number within one square inch, then multiplying by the number of square inches in the plot.

If grasses, algae or other plants are not too dense, they can be counted individually. Otherwise, have students measure the surface area, in inches, that each species occupies.

Make a note of inanimate evidence of life found in a plot--seashells, detached seaweed, bird feathers, animal tracks, or droppings.



RECORDER NAME:	
PLOT LOCATION: transect A plot 2	
DATE: April 2	TIME: 1:15
WEATHER: cloudy, light wind, low tid	
PLANT/ANIMAL:	NUMBER
barnacle	25
limpet	2

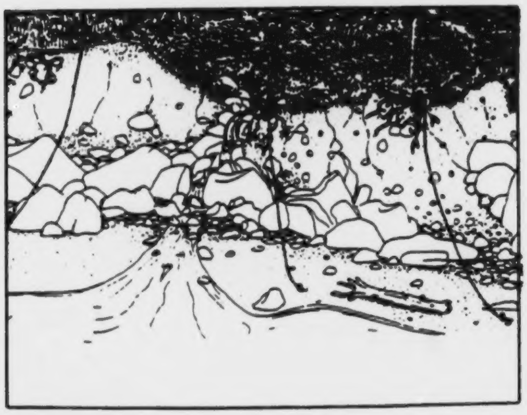
4. To be sure that students understand the procedures, you may want to try sampling in the classroom or on the school playground before you do your field study. Place construction paper plants and animals on the floor or ground. Then have students

mark and measure their study site, sample using random plots or a transect, and summarize data.

5. When you arrive at the study site have each student estimate how many plants and animals are living there.

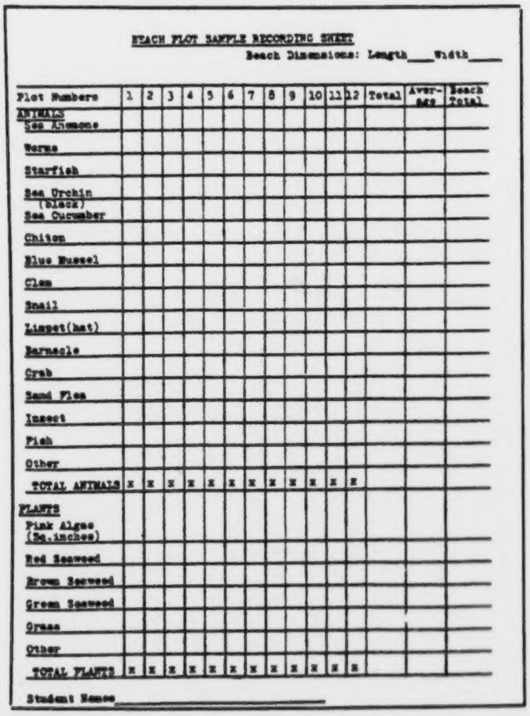
6. Assign one team to be reporters. They can photograph or draw the entire operation and interview the biologists at work. Be sure they photograph or draw the whole of the study site and the bench marks at the beginning and end of each transect. If you have two cameras, you might want to put black-and-white film in one and color slide film in the other. Have students write a story about their class findings for your local school or community newspaper or parent newsletter.

7. Another team (more than one team if there is time) should draw a map of the study site showing prominent biological, geographical and geologic features, along with any manmade features. One student can establish scale for the map by measuring his or her normal stride with the yardstick, then pacing off the size of the study site.



8. After the teams have finished their sampling, hold a summary session. Have each pair tell briefly of its findings. Try to look at the study site as a whole. What are its general characteristics?

9. Back at school, have each team record its findings on a data summary sheet. (A data summary sheet can also be used in the field instead of the field notebooks. If you've been to the study site before and are aware of what you'll find, you can draw up your own sheet ahead of time. Or students can make their own as they go along by writing down each plant or animal the first time they find it.)

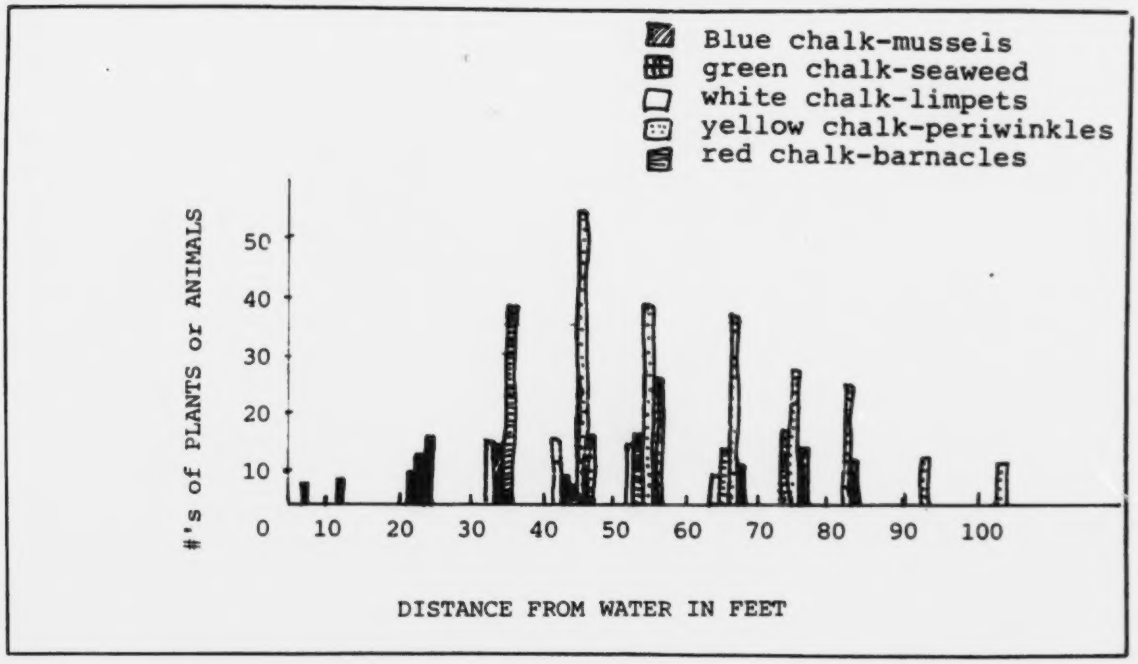


BEACH PLOT SAMPLE RECORDING SHEET

Beach Dimensions: Length___Width____

Plot Numbers	1	2	3	4	5	6	7	8	9	10	11	12	Total	Average	Beach Total
ANIMALS Sea Anemone															
Worms															
Starfish															
Sea Urchin (black)															
Sea Cucumber															
Chiton															
Blue Mussel															
Clam															
Snail															
Limpet(hat)															
Barnacle															
Crab															
Sand Flea															
Insect															
Fish															
Other															
TOTAL ANIMALS	x	x	x	x	x	x	x	x	x	x	x	x			
PLANTS Pink Algae (Sq.inches)															
Red Seaweed															
Brown Seaweed															
Green Seaweed															
Grass															
Other															
TOTAL PLANTS	x	x	x	x	x	x	x	x	x	x	x	x			

Student Names________________________



10. Have the teams make bar graphs of their results, so that they can see graphically how populations of animals and plants vary at your study site.

11. To compute the average number of animals or plants per plot, divide the total number recorded by the number of plots sampled.

To figure the number of animals or plants on the entire study site, use this formula:

$$\frac{\text{total square inches on study site}}{\text{total square inches in plot}} = \text{total plots on study site}$$

average on plots sampled x total plots = total creatures on study site

For example, say you found a total of 1500 barnacles in 10 plots. 1500 ÷ 10 gives you an average of 150 barnacles per plot.

Figure out the number of square inches in your coat hanger plot (9 x-9 in. coat hangers = 81 sq. in.) and the average number of barnacles per square inch:

150 ÷ 81 = 1.85 barnacles per sq. in.

Now to estimate the number of barnacles on your study site, figure the number of square inches in your study site. Assuming a site 100 ft x 40 ft;

100 x 40 = 4,000 sq.ft.

4,000 x 144 (sq. in./sq. ft.) = 576,000 sq. in.

and

576,000 x 1.85 = 1,065,600 barnacles in your study site.

These figures may be more meaningful if they are translated into creatures per acre One acre equals 43,560 sq. ft., or 6,272,640 sq.in. Thus, in the example:

1.85 barnacles/sq. in. x

6,272,640 sq. in./acre =

11,604,384 barnacles per acre.

12. Have students analyze and summarize their data. Ask them:

    - What species are most abundant?
    - What species are most widely distributed?
    - Is there much size range within individual species?
    - What species are present but represented only by a few individuals?
    - What natural changes are occurring within the study site?
    - What accounts for the abundance of life in the sample plots?
    - What human changes do you foresee in the future for this area?
    - How will the animals and plants change in response to these human changes?

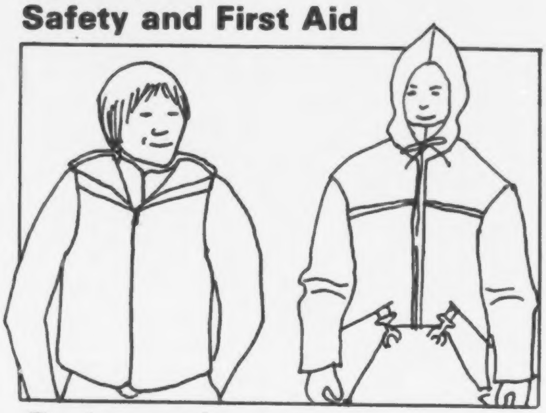
13. Show your results to local officials and SAVE YOUR FIELD NOTES AND SUMMARY REPORT! Emphasize to students that their data will be kept and compared with additional data taken the following year at the same time. (Or if possible, repeat the above sampling scheme in the fall, winter and spring, to measure seasonal change in the study area.) But most important is the fact that in some remote areas of Alaska, your surveys may be the only ones that have ever been made. Your reports might be of real help to scientists.

Additional Activities:

1. Science, Mathematics: Have students measure and record sizes of the largest and smallest plants and animals within the plots.

2. Science, Language Arts, Art: Have students write up questions they have about their findings and about specific plants and animals. Then research the answers to these questions and design an attractive bulletin board display with the results.

Activity 3
Safety and First Aid



Background:

Safety should always be foremost in everyone's mind. Sea Week camp is an excellent opportunity to develop and practice safety consciousness, which ideally becomes a life-long habit. By learning first aid, students may be able to help others as well as themselves.

Vocabulary:

- hypothermia
- resuscitation
- PFD (personal flotation device or life jacket)

Materials:

- various PFDs (life rings, float coat, coveralls, life vest, survival suit)
- thermometers
- first aid books (check the bibliography)
- first aid resource person
- catsup
- blankets

- assorted bandages and first aid supplies
- earthquake victims role cards
- worksheets:
  ...Putting on your PFD (8A)
  ...Water Safety Cartoons (8B)

Procedure:

1. Discuss with students the importance of safety around the water. Bring up local examples of water tragedies and how proper safety procedures could have prevented them. Demonstrate different PFDs (personal flotation devices) and have students try them on.

   Pass out the worksheet Putting on your PFD. To complete this worksheet, students will need to know the local water temperature, so plan time to use thermometers in the water during or before class.

   (Much of the information in this worksheet was obtained from a little pamphlet entitled Hypothermia and Cold Water Survival, by Mustang Industries, which is based on research at the University of Victoria. The pamphlet is available from Mustang Industries, Inc., 3810 Jacombs Road, Richmond, B.C., Canada V6V 1Y6.) Answers: 9a. excellent; 9b. poor; 9c. good; 9d. poor; 9e. fair; 9f. good; 9g. good; 10. Explain that the purchaser of a PFD should look for one that is comfortable to wear and provides maximum protection for the money.

2. Distribute the worksheet Water Safety Cartoons and discuss the different statements. Which ones apply to the Sea Week camping venture? Remind them that safety is no laughing matter, but sometimes cartoons and jokes can help a person remember.

3. If at all possible, give students the chance to learn how to swim and a chance to try out PFDs in the water. Children tend to panic when they are in an unfamiliar environment, and violent movement of arms and legs in an attempt to climb out of the water tends to nullify the stability of a PFD. Children should feel comfortable in their PFDs and know what they're for and how they function in the water.

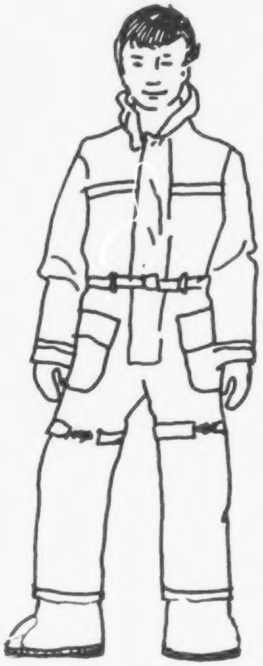
4. Arrange for someone knowledgeable in first aid techniques source person to come in and work with your class on first aid procedures. Repeatedly go over the four principles of first aid:

   Check and Clear the Airway
   Stop the Bleeding
   Protect the Wounds
   Treat for Shock

   Be sure students learn the correct procedures for artificial respiration and CPR (cardiopulmonary resuscitation). You may want to order the pamphlets First Aid for the Boatman, Boating Tips for Sportsmen and Cold Water Drowning from the U.S. Coast Guard, Bosteam 17, P.O. Box 2471, Anchorage, Alaska 99510.

5. As a practice of their first aid skills, stage the potential results of an earthquake. Pick eight students as victims (using catsup for blood) and have the other students treat them for injuries with assorted bandages and blankets. Do this activity at camp if you don't think it will give the students nightmares!

Explain that oftentimes on the coast, just before a tsunami hits, the tide will go way, way out. Then there is a roaring as the wave rolls in, so race for higher ground! The rule of thumb is that if the quake lasts longer than 30 seconds or if you cannot stand up when it happens, beware of a tsunami. You may only have five minutes before it hits, if, of course, the epicenter is nearby. If the epicenter is far away, the quake may not feel that strong, but a tsunami still may hit. The Tsunami Warning Center takes 15 minutes to process information about a quake, which it then relays to radio stations. So it is a good idea to turn on your radio anytime you feel an earthquake. Ask students to research stories about the famous earthquake that shook Alaska in 1964.



EARTHQUAKE VICTIMS ROLE CARDS

As you tried to run out of the cabin, a bookcase fell over and broke your arm and sprained your ankle. You are in shock and can't think of what to do next.

You were doing dishes when all the china in the cupboards of your cabin fell out and cut you badly all over your body. Blood is spurting out of a severe gash on your arm. The sight of your own blood has caused you to faint.

You were putting wood in your stove when the quake hit. The stove fell on you and burned your arms and legs badly. Your clothes are smoldering and you run screaming out of the house to get away from everything.

You were fishing near shore when the quake hit. Your boat was wrecked on the rocks and you were thrown out on the beach, near-drowned and unconscious.

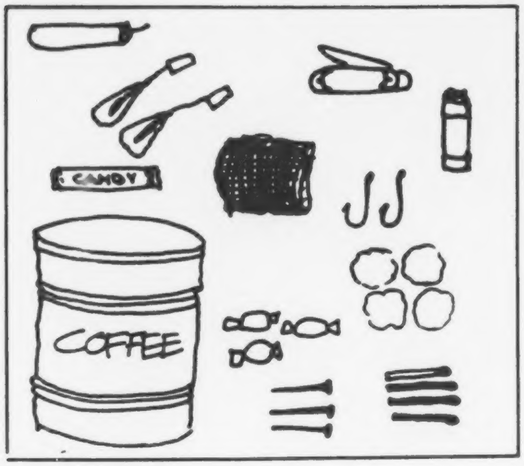
You were chopping wood when the quake hit. The axe hit your knee and split it wide open. Blood is gushing out and you're in shock.

You were up in a tree scouting for wildlife. The quake knocked you out and broke your back when you fell out of the tree.

You were eating fish when the quake struck. The table fell over on you and broke your leg. You also have a bone stuck in your throat. You keep trying to cough it out but it's still stuck.

You were in the shed filling the gas tanks for your boat. All kinds of junk fell on top of you, crushing your leg and pinning you in. Now the fumes are overcoming you.

Activity 4
Survival



Background:

Every Alaskan should know basic survival skills. The best advice is be prepared. Always have survival gear in your boat, plane, snowmachine, dog sled or car. A small booklet called Cold Weather Survival, available from the Alaska Department of Fish and Game, is helpful.

Materials:

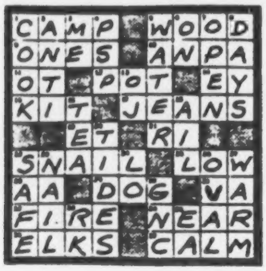
(These materials will make a survival kit for each student. Excerpted and adapted from "Coffee Can Survival Kit" by Hank Pennington, University of Alaska. As published in Alaska Tidelines, Volume II, Number 8, May 1980. Copyright © 1980. Published by the University of Alaska Sea Grant Program. Reprinted by permission.)

- coffee can
- 6x8-foot sheet of plastic (Fold tightly and place in the coffee can first, as a kind of lining around the sides.)
- three feet of heavy aluminum foil (many uses: cooking; signaling, as with a mirror; fishing lures, etc.)
- two 10-inch zip-lock plastic bags (for carrying water; storing and carrying food.)
- 25 feet nylon parachute cord
- 50 feet nylon twine (small)
- 30 feet fine snare wire (For making snares, net hoops, loop handle for the coffee can)
- 3x5-foot piece of gillnet
- 25 feet of 20 lbs. test fishing line
- fish hooks: 6 #1/0 hooks and 6 #6 hooks
- four large 20d nails
- pocket knife (good quality Scout-type)
- wire saw (small, flexible)
- Disposable propane cigarette lighter
- cotton balls (Good for quick wet wood fire starter.)
- 4" x 3/4" candle
- powdered coffee, tea or fruit drink (to flavor your water and keep fluid consumption high)
- hard candy (high energy food)
- survival food (dry soups, candy bars, etc.)
- waterproof matches (wooden kitchen matches dipped in paraffin)
- gray duct tape to seal the coffee cans shut
- worksheets:
  ...How to Survive on a Beach (8C)
  ...Survival Puzzle (8D)
  ...Beachcombing Trip (8E)

Procedure:

1. Discuss local survival stories. Have students imagine situations in which they might need to use survival skills. Pass out the worksheet How to Survive on a Beach. If your students are from the Interior, have them think about the differences between

coastal and inland areas as they read the story. They may also want to try problem no. 3 on the review worksheet, Safety and Survival (7P). As a follow-up, have students do the worksheet, Survival Puzzle. (Solution below:)



C	A	M	P	■	W	O	O	D
O	N	E	S	■	A	W	P	A
O	T	■	P	O	T	■	E	Y
K	I	T	■	J	E	A	N	S
■	■	E	T	■	R	I	■	■
S	N	A	I	L	■	L	O	W
A	A	■	D	O	G	■	V	A
F	I	R	E	■	N	E	A	R
E	L	K	S	■	C	A	L	M

2. Have students make up coffee can survival kits. Use the materials listed above. Students may be able to scrounge items from home to include in their cans. Discuss additional items such as hatchets, first aid kits, sharpening files.

3. Have students read the worksheet Beachcombing Trip. Talk about how often accidents happen so fast there is no chance to grab your survival kit or gear. That is why it is important to dress warmly. Often in a survival situation, all you end up with is what is on your back and what is in your pockets. Ask students what they should include, and have them make up their own pocket survival kits.

4. Have students write survival guides for their own community. What shelter, warmth, water and food can they expect? Will they be prepared? Have them end their survival guides with a creative story about the time they had to survive.

Activity 5
The Camp's Future

(a simulation game)

SHORE HIGHWAY
BAYTOWN
CAMP
X

Background:

Controversial issues are an important part of the Sea Week Curriculum Series. By having students take a look at their Sea Week campsite, they can perceive and better understand some of the development issues facing Alaska. This game is similar to the coastal zone management game in Unit 1, Activity 2, but it is less structured and more open-ended.

Materials:

- butcher paper
- felt-tip markers
- topographic maps of the area
- construction paper
- scissors

Procedure:

1. Bring the group to a spot where they can get an overview of the whole camping site. Ask them to brainstorm different development alternatives (houses, businesses, industry, or keeping it like it is). Discuss the advantages

and disadvantages of development. In small groups, have students come up with specific plans for each development alternative. Butcher paper, felt-tip markers and topographic maps can be used to develop charts for each group's presentation. Instruct each group to prepare a three-minute presentation. Before they get too far along, ask each group to elect a borough commissioner, and have the commissioner meet in their own group.

2. Ask the commissioners to come up with criteria for the plans.

3. After about 15-20 minutes, have the commissioners call a town or village meeting. Each group makes a presentation. Allow a few minutes after each presentation for questions from commissioners and from the audience.

4. Have the commissioners make their decision and present it to the group. Discuss the actual future of your camping site. What will it look like in 10-20 years? What will your community look like? What role will your students play in its development?

Bibliography

Compiled by Belle Mickelson, Peggy Cowan, Mary Lou King, Nancy Barr and Dr. Earl Clark, associate professor, University of Alaska, Juneau, and his students Joyce M. Roloff, Linda Edmondson, Patricia Muchnick, Dan Penrose, Chris Winter, and Tom Castagnola.

Selections from the following annotated bibliographies are included in this volume. Consult these excellent sources for additional suggestions for Sea Week books.

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Lee, Richard S. and F.F. Wright. Bibliography of Marine Teaching Materials. Marine Advisory Program, Cooperative Extension Service, University of Alaska, Anchorage, AK 99504. 1976. 40 p.

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UNIT 1--THE VALUES OF RIVERS, WETLANDS AND THE SEA

Alaska Geographic Society. *Anchorage and the Cook Inlet Basin*. *Alaska Geographic* Vol. 10, No. 2, 1983.

Typical *Alaska Geographic*, with photographs and extensive accompanying text, but also includes a forecast map of Anchorage 2035.

Amos, W.H. *The Life of the Seashore*. McGraw-Hill Book Co., New York, 1966. 231 p.

Stresses ecological relationships, with color photographs and line drawings describing the marine life. One of the Our Living World of Nature series developed in cooperation with The World Book Encyclopedia.

Bascon, Willard, ed. *Great Sea Poetry*. Compass Publications, Arlington, Va., 1969. 119 p.

Descriptive, emotion-filled lines from Rudyard Kipling, A.A. Milne, John Masefield, Lewis Carroll, Matthew Arnold, Robert Browning, Oliver Wendell Holmes, Sir William Gilbert, John Gray and J. Frank Stinson. Complete with a glossary and gazetteer.

Berger, Melvin. *Oceanography Lab*. Scientists at Work series. John Day Co., New York. 126 p.

Examines the daily work of women and men doing ocean research at the Woods Hole Oceanographic Institution.

Carlisle, Norman. *The New American Continent: Our Continental Shelf*. J.B. Lippincott Co., New York. 96 p.

Future-focused and scientific account of exploring, protecting, developing and living on the continental shelf. Many photographs.

Carson, Rachel. *The Edge of the Sea*. Houghton Mifflin Co., Boston, 1955. 276 p.

Detailed descriptions of East Coast intertidal life, with an appendix explaining the animals' scientific classifications.

Carson, Rachel L. *The Sea Around Us*. Oxford University Press, New York, 1961. 237 p.

Lyrical text that narrates the story of the ocean and the way it affects our lives.

Bardach, John. Downstream: A Natural History of the River from its Source to the Sea. Grosset and Dunlap, New York, 1964. 278 p.

Describes river and stream ecology, habitats and inhabitants; also examines the human factor.

Clarke, Arthur C. The Challenge of the Sea. Illustrated by Alex Schonburg. Holt, Rinehart and Winston, New York, 1980. 168 p.

Comprehensive study of people's interaction with the sea, past and present. Written engagingly in easily understood narrative. Covers topics from Atlantis to an underwater hotel of the future; from the invention of the diving bell to plankton farming; from sightings of sea serpents to the language of whales.

Cole, William. The Sea, Ships and Sailors. Illustrated by Robin Jacques. Viking Press, New York, 1967. 236 p.

Collection of maritime poetry and songs recounting tales of voyages to far-off lands. Rings with the rhythm of work on ships.

Coleridge, Samuel Taylor. The Rhyme of the Ancient Mariner. (In numerous anthologies.)

Classic epic poem of maritime life.

Coombs, Charles. Deep-Sea World: The Story of Oceanography. William Morrow and Co., New York, 1966. 251 p.

Emphasis on human uses and abuses of the sea. Comprehensive coverage of oceanography.

Dana, Richard H., Jr. Two Years Before the Mast. Random House (Modern Library), Westminister, Md., 1945. 423 p. (Available in numerous editions.)

Classic first-hand account of life at sea around Cape Horn in the mid-19th century.

Davis, J.C. Fish Cookery. A.S. Barnes and Co., South Brunswick, N.J, 1967. 226 p.

A surprising collection that, in addition to good advice on standard fish cooking, gives many interesting and exotic recipes. If you bring anything from an octopus to a whale home from fishing, this book will tell you how to prepare it.

Dennon, Jerry. The Salmon Cookbook. Pacific Search Press, Seattle, 1978. 127 p.

Many delicious recipes, together with salmon history, species descriptions and explanations of spawning and migration patterns, aquaculture, and cooking and cleaning techniques. Highlighted with pen-and-ink drawings.

Engel, Leonard and the editors of Time-Life Books. The Sea. Time-Life Books, Alexandria, Va., 1979. 128 p.

Many color drawings and a few photographs complement the text, which gives an overview of oceanography, invertebrates, sharks, marine mammals, and the future of man and the sea.

Field, Edward, ed. Eskimo Songs and Stories. Illustrated by Kiakshuk and Pudlo. Delacorte, New York, 1973. 102 p.

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Flora, C.J. The Sound and the Sea: A Guide to Northwestern Neritic Invertebrate Zoology. Washington State Dept. of Printing, Olympia, 1977. 474 p.

Species-by-species description of seashore animals. Black-and-white photographs of almost every species make this volume easy to use as a field guide.

Friese, V. Erich. Marine Invertebrates. TFH Publications, Neptune, N.J., 1967.

Beautifully illustrated book describing all types of marine invertebrates.

Furlong, Marjorie and Virginia Pill. Edible? Incredible! Pondlife. Naturegraph Publishers, Happy Camps, Calif., 1980. 95 p.

Photographs and text describes pondlife and how to prepare it as food. Helpful hints on where to find species.

Fenten, D.X. Sea Careers. J.B. Lippincott Co., Philadelphia, 1970. 162 p.

Extensive list of jobs related to the ocean. Description, required qualifications and schooling, information sources and applications outlined for each job.

Forman, James. So Ends This Day. Farrar, Straus and Giroux, New York, 1970. 274 p.

Adventure on the sea in the days of whaling ships and slave running.

Gaskell, T.F., ed. Using the Ocean. Queen Anne Press, Queenstown, Md., 1970.

Topical essays on using the sea. Examines mineral exploration, submarine archeology and other topics.

Hemingway, Ernest. The Old Man and the Sea. Charles Scribner's Sons, New York, 1952. 127 p.

The classic big-fish story about on old Cuban fisherman and a giant marlin.

Holling, Clancy Holling. Seabird. Houghton Mifflin Co., Boston, 1948. 60 p.

Beautifully detailed drawings and compelling text tell the adventures of an ivory gull as it accompanies a young boy on a whaling vessel. Narrative follows generations down to a great grandson who is an airline pilot. Scenes of beauty, danger and excitement from different periods of American history.

Horsfield, Brenda and Peter B. Stone. The Great Ocean Business. Coward, McCann and Geoghegan, New York, 1972. 360 p.

Survey of ocean industries in the '50s, '60s and early '70s. Excellent reference.

Morgan, Elizabeth. In the Deep Blue Sea. Illustrated by Peter P. Plasencia. Prentice-Hall, Englewood, N.J., 1962. 70 p.

Present and past research on ocean exploration, ocean mining, harvesting of ocean crops, and archaeological fossils of the deep. Explains jobs involved in work under the sea.

Marx, W. The Frail Ocean. Ballantine Books, New York, 1967. 274 p.

Current topics including conservation and management of marine resources for the future. A pessimistic but fascinating discussion.

McCoy, J.J. A Sea of Troubles. Illustrated by Richard Cuffan. Houghton Mifflin Co., Boston, 1975. 192 p.

Present-day threats to the future of the world's oceans.

Pinkerton, Katherine. Hidden Harbor. Harcourt, Brace and World, New York, 1951. 278 p.

The story of a Southeast Alaska wilderness family in the early 1900s as their teenage son figures out how to replace their rotting sailboat.

Pinkerton, Katherine. Steer North! Harcourt, Brace and World, New York, 1962. 219 p.

Another of the author's Southeast Alaska stories. This one features a teenage boy who sails north to find a job in Ketchikan.

Ransom, M.A. with Eloise Katherine Engle. Sea of the Bear. U.S. Naval Institute, Annapolis, 1964. 119 p.

Journal of an interesting 1921 voyage to Alaska by a young Coast Guardsman aboard the Bear. Has fine photographs taken with a drugstore-type Eastman Kodak camera.

Ross, Frank, Jr. Jobs in Marine Science. Lothrop, Lee and Shepard Books, New York, 1974. 95 p.

Describes marine careers, how a young person can prepare for each, and where to write for more information. Easy-to-understand text portrays salvage divers, party boat captain, marine geophysicist, fish farmer, chemical oceanographer and others.

Sherman, Diane. You and the Ocean. Illustrated by Bill Sanders. Childrens Press, Chicago, 1965. 61 p.

Describes work of scientists in the ocean world, providing basic information on oceanography and marine biology. Beautifully illustrated.

Silverstein, Alvin and Virginia. The Long Voyage: The Life of the Green Turtle. Frederick Warne and Co., New York, 1972. 48 p.

Introduces marine research and the idea of the balance of nature through an account of a team of scientists journeying across open ocean in order to trace the life cycle of the turtle.

Sterling, Philip. Sea and Earth: The Life of Rachel Carson. Women of America. Thomas Y. Crowell Co., New York, 1970. 213 p.

Interesting coverage of the life and works of a skilled scientist and gifted writer. Illustrated with family photographs.

Stetson, Marguerite, ed. The Fisherman Returns. Cooperative Extension Service and U.S. Dept. of Agriculture, University of Alaska, Fairbanks, 1982 (revised). 59 p.

Preparation and preservation instructions plus recipes and nutrition information.

Syne, Ronald. The Travels of Captain Cook. Photographs by Werner Forman. McGraw-Hill Book Co., New York, 1971. 180 p.

Analysis and description of Cook's voyages and life. Beautifully illustrated, with large, clear print.

Teal, John and Mildred. Life and Death of the Salt Marsh. Ballantine Books, New York. 274 p.

Tells the past and present of East Coast marshes in a novel-like style. Good background on the importance of wetlands and their ecology.

UNIT 2--MARINE MAMMALS

Ainley, David G., Gary W. Page, Lisa T. Jones, Lynne E. Stenzel, and Ronald L. LeValley. Beached Marine Birds and Mammals of the North American West Coast: A Manual for their Census and Identification. National Coastal Ecosystems Team, Office of Biological Services, U.S. Fish and Wildlife Service (Superintendent of Documents, Stock No. 024-010-00541-6, U.S. Govt. Printing Office, Washington, DC 20402), 1980. 207 p.

Keys to bird and marine mammal carcasses, with line drawings of bird bills and wings and marine mammal skulls and bones.

Alaska Geographic Society. Alaska Whales and Whaling. Alaska Geographic Vol. 5, No. 4., 1978.

Species-by-species accounts of Alaska whales and whaling history. Photographs, drawings and range maps complement the text.

Angell, Tony. Marine Birds and Mammals of Puget Sound. Drawings by author. Washington Sea Grant publication, University of Washington Press (available by writing University of Washington Press, Seattle, WA 98105), 1982. 160 p.

The Alaska Fisherman's Journal says, "This book is worth the price for Tony Angell's drawings alone--and there is much more...Descriptions of the various species--grebes, gulls, terns, seals, sea lions, dolphins, whales--are detailed, succinct and sometimes written with passion." All birds and mammals featured are found in Alaska. Stunningly illustrated. Includes maps, tables, bibliography.

Armour, Richard. Sea Full of Whales. Illustrated by Paul Galdone. McGraw-Hill Book Co., New York, 1974.

Humorous poems entertain and convey facts about blue, killer, humpback, finback, right, pilot and sperm whales, narwhals, dolphins and porpoises. Charming sketches.

Audubon, Vol. 77, No. 1, Jan. 1975. Reprinted by the Rare Animal Relief Effort, New York.

A special issue devoted to cetaceans, with portraits of 24 species.

Bird, James E. Whales, Whaling, Dolphins and Porpoises: An Annotated Bibliography. American Cetacean Society (P.O. Box 22305, San Diego, CA 92122) 1977. 85 p.

Approximately 500 references on whales, whaling, dolphins and porpoises. Annotations indicate reading level, interest level, and a brief description of content. Includes books, magazine articles, tapes, records and films. Special attention is given to books suitable for children.

Bleeker, Sonia. The Sea Hunters Indians of the Northeast Coast. Greenwillow/Morrow, New York, 1951. 159 p.

Traditional hunting of marine mammals in Alaska.

Blackerby, Alva W. Tale of an Alaska Whale. Binfords and Mort, Portland, Ore., 1955. 30 p.

One of the few books that deals with whales in Alaska.

Bradey, Irene. Elephants on the Beach. Charles Scribner's and Sons, New York, 1979. 31 p.

Sketches and observations of a bull elephant seal, his harem and calves. Done with warmth, humor and realistic details.

Bray, Mary Matthews. A Sea Trip in Clipper Ship Days. Richard G. Badger, The Gorham Press, Boston, 1920. 164 p.

The author describes a trip aboard her father's clipper ship from Boston to New Orleans to Liverpool to India and back, 1858-1860.

Brown, Joseph E. Wonders of Seals and Sea Lions. Dodd, Mead, and Co., New York, 1976. 80 p.

Characteristics, habits and training of seals and sea lions, with photographs.

Brown, Robin. The Lure of the Dolphin. Avon Books, New York, 1979. 233 p.

Dolphin experiences written by a journalist film maker.

Bullen, Frank D. The Cruise of the "Cachalot". Appleton, New York, 1927.

Excellent story of life aboard a whaler.

Carrighar, Sally. The Twilight Seas: A Blue Whale Journey. Illustrated by Peter Parnell. Ballantine Books, New York, 1975.

Fictionalized account of the life voyage of a great blue whale.

Chadwick, Roxane. Don't Shoot. Lerner Publications, Minneapolis, 1978. 38 p.

Eskimo boy plans to protect Alaska's polar bears and other animals from poachers.

Chapin, Henry. Remarkable Dolphin and What Makes Him So. Illustrated by Richard Rice. Scott, New York, 1970. 90 p.

Navigational abilities and brain complexity are emphasized in book about these friendly and graceful creatures.

Church, A.C. *Whale Ships and Whaling*. 1938. Reprint. W.W. Norton and Co., New York, 1960. 179 p.

Contains 200 photographs plus 40 pages of text describing the whaling industry.

Coerr, Eleanor and William Evans. *Gigi: A Baby Whale Borrowed for Science and Returned to the Sea*. G.P. Putnam's Sons, New York, 1980. 128 p.

Working scientists' respect for the life they study is conveyed skillfully, as the story of a whale's capture and its life in captivity unfolds.

Coffey, D.J. *Dolphins, Whales and Porpoises - An Encyclopedia of Sea Mammals*. MacMillan Publishing Co., New York, 1977.

Text and a multitude of photographs. Deals with seals, sea lions and walruses as well as cetaceans.

Collins, Blackie and Michael. *How to Scrimshaw and Carve Ivory*. Knife World Books, Knotville, 1978. 45 p.

Craft pamphlet illustrating carving methods, with photographs of finished projects.

Conklin, Gladys. *Journey of the Grey Whales*. Illustrated by Leonard E. Fisher. Holiday House, New York, 1977. 39 p.

Follows the activities of a whale, the birth of her calf and their migration from Mexico to the Bering Sea.

Cook, Joseph J. and William L. Wisner. *Blue Whale, Vanishing Leviathan*. Dodd, Mead and Co., New York, 1973.

Discusses blue whale anatomy and habits, and the overhunting that led to their near extinction. Accompanied by photographs and illustrations.

Cousteau, Jacques-Yves and Philippe Diol'e. *The Whale: Mighty Monarch of the Sea*. A&W Visual Library, New York, 1972. 304 p.

Extensive text and several color photographs of whales, in Cousteau style.

Cousteau, Jacques-Yves and Philippe Diol'e. *Dolphins*. A&W Visual Library, New York, 1975. 304 p.

Describes Cousteau's encounters with dolphins. Accompanied by color photographs.

Cutter, Carl C. *Greyhounds of the Sea: The Story of the American Clipper Ship*. Halcyon House of G.P. Putnam's Sons, New York, 1930. Reprinted. U.S. Naval Institute, Annapolis, 1961. 3 Vols., 592 p.

The best general history of American clipper ships.

Daugherty, Anita E. Marine Mammals of California. California Dept. of Fish and Game, Sacramento, 1972. 91 p.

Excellent pocket-sized paperback that describes each species. Illustrated with line drawings and a few photographs.

Davidson, Margaret. Nine True Dolphin Stories. Illustrated by Roger Wilson. Holiday House, New York, 1974. 64 p.

Fascinating collection of dolphin facts. Enjoyable reading.

Davies, Brian. Seal Song. Viking Press, New York, 1978. 93 p.

Photographic picture book tells life history of Canadian harp seal and discusses the pros and cons of seal hunting.

Dozier, Thomas A. Whales and Other Sea Mammals. Time-Life Films, 1977. 128 p.

Picture-book format, with beautiful color photographs. Text based on the television series, Wild, Wild World of Animals.

Dulles, Foster R. Lowered Boats; A Chronicle of American Whaling. Harcourt, Brace and Co., New York, 1933. 292 p.

An easy-to-read history.

Ellis, Richard. The Book of Whales. Alfred A. Knopf, New York, 1980. 202 p.

Excellent, comprehensive coverage of whale species worldwide. Big picture-book format, with line drawings and color paintings.

Friends of the Earth. The Whale Manual. Friends of the Earth, San Francisco, 1978. 155 p.

An assessment of the whaling controversy, with chapters on the economics and politics of whaling, substitutes for whale products, and alternatives to whaling.

Gatenby, Greg, ed. Whale Sound. J.J. Douglas, North Vancouver, B.C., 1977. 96 p.

Anthology of poems about whales and dolphins.

George, Twig. Whales. Illustrated by Lyle Bennett. Center for Environmental Education, Washington, D.C.

Fact sheets on fourteen whale species.

Gordon, Ester and Bernard. *Once There was a Giant Sea Cow*. Illustrated by Pamela Baldwin Ford. Henry Z. Walck, New York, 1977.

Story of exploration and of the animals discovered by Captain Vitus Bering and George William Stellar in 1741. Writing disjointed.

Graham, Ada and Frank. *Whale Watch: An Audubon Reader*. Delacorte Press, New York, 1978.

Describes the "Save the Whale" movement in a style intended for young students.

Grant, Gordon. *Greasy Luck*. 1932. Reprint. Caravan Maritime Books, Samnica, N.Y., 1970.

A whaling sketchbook with brief descriptive text by an artist with a genuine knowledge of seagoing ships.

Griggs, Tamar. *There's a Sound in the Sea: A Child's-Eye View of the Whale*. The Scrimshaw Press, 1975. 93 p.

Drawings and poems by children, expressing their feelings about whales.

Haig-Brown, Roderick. *The Whale People*. Illustrated by Mary Weiler. Collins, London, 1962. 184 p.

Life of Native people, whaling, potlatch and whale dance described in a story about the son of a chief.

Haley, Delphine, ed. *Marine Mammals of Eastern North Pacific and Arctic Waters*. Pacific Search Press, Seattle, 1978. 256 p.

Written by 21 marine mammal authorities for a general audience. Includes photographs, line drawings and distribution maps.

Haley, Nelson Cole. *Whale Hunt*. Ives Washburn, New York, 1967.

Story based on the journal of Nelson Haley, who sailed out of New Bedford in 1849 aboard the whaler *Charles W. Morgan*.

Hausman, Gerald. *The Day the White Whales Came to Bangor*. Illustrated by Margot Apple. Cobblesmith, Freeport, 1979. 34 p.

The intriguing story of the controversy stirred up when beluga whales came up the Penobscot River to the inland community of Bangor, Maine. Easy reading with whimsical, annotated line drawings. Good lead-in for a student discussion of what would happen if whales should show up in their community.

Hegarty, Reginald B. *The Rope's End*. Illustrated by Wallace Tripp. Houghton Mifflin Co., Boston, 1964. 131 p.

Life on a whaling vessel for a boy whose behavior often results in the seat of his pants meeting with a "rope's end."

Hogner, Dorothy Childs. Sea Mammals. Illustrated by Patricia Collins. Thomas Y. Crowell, New York, 1979. 81 p.

Listing and description of mammals habits, physical characteristics, scientific and common names. Urges protection and conservation.

Hough, Henry B. Great Days of Whaling. Houghton Mifflin Co., Boston, 1958. 184 p.

Series of adventures on a whaling voyage. Written for students. Good illustrations and a glossary.

Hunter, Robert. To Save a Whale: the Voyages of Greenpeace. Chronical Books, San Francisco, 1978. 119 p.

The story of Greenpeace Foundation's attempts to stop whaling by confrontations with the Russian whaling fleet. Illustrated with photographs.

First Aid for Stranded Marine Mammals. International Fund for Animal Welfare (P.O. Box 193, Yarmouth Port, MA 02675). 29 p.

Identification, first aid, proper record keeping and notification of authorities simply explained.

Jacobs, Lou, Jr. Four Walruses from Arctic to Oceanarium. Young Scott Books, New York, 1968. 62 p.

True-life account of the life of walrus captured in Alaska and raised in California. Animals treated as individuals.

Johnston, Johanna. Whale's Way. Illustrated by Leonard Weisgard. Doubleday and Co., New York, 1965. 45 p.

Emphasizes differences between whales and land mammals. A year in the life of a whale chronicled.

Kelly, John. The Great Whale Book. The Center for Environmental Education, Acropolis Books, Washington, D.C., 1981. 116 p.

A good synopsis of the whale species and their status.

Kirk, Ruth and Richard D. Daugherty. Hunters of the Whale: An Adventure in Northwest Archaeology. William Morrow and Co., New York, 1974. 160 p.

Archaeology team works to reconstruct an Indian whaling village. Photographs and maps.

Kipling, Rudyard. How the Whale got his Throat. Illustrated by Don Madden. Addison-Wesley, Reading, Mass. 30 p.

A wise and resourceful man keeps the whale from devouring all the fish in the sea. Ageless story.

Kohn, Bernice. *All Kinds of Seals*. Random House, New York, 1968. 81 p.

Seals' environment and their relationship to humans, with explanation of how they evolved from land to sea animals.

L'Engle, Madeleine. *Ring of Endless Light*. Farrar, Straus and Giroux, New York, 1980. 324 p.

Story of a family's summer visit to their grandfather's island home. They join in the study of dolphin communication both at sea and in tanks.

Lauber, Patricia. *Sea Otters and Seaweed*. Garrard Publishing Co., Champaign, 1976. 64 p.

Life history of the sea otter, and ecology of its kelp-bed home. Illustrated with photographs.

Lauber, Patricia. *The Friendly Dolphins*. Illustrated by Jean Simpson. Random House, 1963. 79 p.

Dolphins' physical make-up and similarities to other mammals, history as a friend to people, and unique sonar talents are described.

Leatherwood, Stephen. *Whales, Dolphins and Porpoises of the Western North Atlantic: A Guide to their Identification. National Marine Fisheries Service Cir. No. 395, Seattle, 1976.* 176 p.

Excellent field identification to these marine mammals. Black-and-white photographs.

Leavitt, John F. *The Charles W. Morgan*. Marine Historical Assoc., Mystic, Conn., 1973. 131 p.

Comprehensive history of the ship, with photographs and sketches.

Lewin, Ted. *World Within a World: Pribilofs*. Dodd, Mead and Co., New York, 1980. 76 p.

Describes animals of the Pribilof Islands, emphasizing seals.

Lilly, John C. *Lilly on Dolphins*. Anchor Press, New York, 1975. 500 p.

Relates the author's attempts to communicate with dolphins.

Lindop, Edmund. *Pelorus Jack, Dolphin Pilot*. Viking Press, New York, 1964. 32 p.

True story of a dolphin who guided ships through rocky channels off New Zealand.

Lyon, Jane D. Clipper Ships and Captains. American Heritage Publishing Co., New York, 1962. 153 p.

Excellent introduction to clipper ships, the men who sailed them, and the age that produced them. Well-illustrated with photographs, paintings, drawings and maps.

Matthews, Leonard Harrison, et al. The Whale. Simon and Schuster, New York, 1968. Reprint. Crescent Books, 1975. 287 p.

Collection of essays by international experts, covering folklore, politics, history and economics of the great whales.

Maxwell, Gavin. Seals of the World. Houghton Mifflin Co., Boston, 1967. 151 p.

Technical, well-written and illustrated review of seal ecology.

Meadowcraft, Enid L. When Nantucket Men Went Whaling. Garrard Publishing Co., Champaign, Ill., 1966. 96 p.

Story of the men and their families whose lives were shaped by whaling.

McCloskey, Robert. Burt Dow, Deep-Water Man. Viking Press, New York, 1963. 63 p.

Old sea salt catches a whale by the tail and winds up in its stomach. Delightful tale of boats, the ocean, and marine life.

McClung, Robert. Hunted Mammals of the Sea. Illustrated by William Downey. William Morrow and Co., New York, 1971. 191 p.

Carefully researched book presents scientific documentation, charts and figures to support its appeal for conservation.

McDearmon, Kay. A Day in the Life of a Sea Otter. Dodd, Mead and Co. New York, 1973. 44 p.

A female sea otter's nurturing of her offspring is described tenderly. Illustrated with photographs.

McDearmon, Kay. Polar Bear. Dodd, Mead and Co., New York, 1976. 46 p.

Life cycle, life style and habitat of the polar bear portrayed in story form. Illustrated with black-and-white photographs.

McDearmon, Kay. The Walrus: Giant of the Arctic Ice. Dodd, Mead and Co., New York, 1974. 45 p.

Follows the life of a female walrus and her calf. Good for sharing in class.

McGovern, Ann. *Little Whale*. Illustrated by John Hamberger. Four Winds Press, New York, 1979. 43 p.

Depicts the life of a humpback whale from birth to adulthood. Includes a glossary of whale words and a note about the danger of whale extinction. Attractive blue, green and brown illustrations.

McIntyre, Joan. *Mind in the Waters*. Charles Scribner's Sons, New York, 1974. 240 p.

Celebrates the consciousness of whales and dolphins. Topics range from myths to brain anatomy to the International Whaling Commission.

McNulty, Faith. *The Great Whales*. Doubleday and Co., New York 1974. 100 p.

Whale natural history in easy-to-understand language.

McNulty, Faith. *Whales: Their Life in the Sea*. Illustrated by John Schoenbarr. Harper and Row, 1975. 88 p.

Descriptions of evolution, biology and physiology of whales, and the story of Gigi, a gray whale. Written for students.

Meader, Stephen. *Whaler 'Round the Horn*. Illustrated by Edward Shenton. Harcourt Brace Jovanovich, New York, 1950. 244 p.

Story of young New Englander's adventures whaling in the Hawaiian Islands.

Melville, Herman. *Moby Dick*. Edited and with an introduction by Charles Child Walcutt. 1851. Reprint. Bantam Books, New York, 1967. 594 p.

The classic story of Captain Ahab's quest for the white whale.

Miller, Tom. *The World of the California Gray Whale*. Baja Trail Publications, Ana, Calif., 1975. 191 p.

Excellent information on the gray whale and other West Coast marine mammals with history, charts, drawings and photographs.

Mowat, Farley. *A Whale for the Killing*. Penguin Books, New York, 1972. 239 p.

Dramatic account of the author's struggle to save a trapped fin whale in Nova Scotia.

Mizumura, Kazue. *The Blue Whale*. Thomas Y. Crowell Co., New York, 1971. 34 p.

Factual account of whales, featuring blue whale. Warns of blue whale extinction.

Murphy, R.C. A Dead Whale or a Stove Boat. Houghton Mifflin Co., Boston, 1967.

Primarily photographs of a 1911-1913 whaling voyage.

National Coordinating Center for Curriculum Development. Whales. Ginn Custom Publishing, Lexington, Mass. 33 p.

An excellent student reader with a variety of selections about whales and a bibliography and glossary.

Nickerson, Roy. Brother Whale: A Pacific Whale Watcher's Log. Chronicle Books, San Francisco, 1977. 155 p.

Focuses on Hawaiian humpbacks (some of which migrate to Alaska). Accompanied by photographs and illustrations.

Norris, Kenneth S. The Porpoise Watcher. W.W. Norton and Co., Shreveport, La., 1975. 250 p.

A naturalist's experiences with porpoises and whales, illustrated with photographs.

Northrup, Everett H. Florence Nightingale of the Ocean. U.S. Merchant Marine Acadamy, Kings Point, New York.

Pamphlet describing how Mary Patten assumed command of the clipper ship Neptune's Car in 1959 when she was 19 years old.

Olmstead, F.A. Incidents of a Whaling Voyage. Charles E. Tuttle Co., Rutland, 1969.

First-hand account of a 1840 whaling voyage--the last word on whaling for a decade before Melville started Moby Dick. Much of the book describes the Sandwich Islands (Hawaii).

Payne, Roger S. and Scott McVay. "Songs of Humpback Whales." Science, Aug. 13, 1971.

Technical article describing humpback whale sounds and their significance.

Phelam, Joseph. The Whale Hunters. Time-Life Books, Alexandria, Va., 1969. 52 p.

Color illustrations of whales and diagrams of boats, navigational equipment and whaling tools add to this account of the adventure of early whaling.

Pike, Gordon C. Guide to the Whales, Porpoises and Dolphins of the Northeast Pacific and Arctic Waters of Canada and Alaska. Circular No. 32. Fisheries Resource Board of Canada, Nanimo, B.C., Aug. 1956. 14 p.

Pluckrose, Henry, ed. Whales. Gloucester Press, New York, 1974. 28 p.

Describes whales and dolphins in simple text. Color illustrations.

The Polar Bear. Paper sculptures No. 3. National Museum of Natural Sciences, National Museums of Canada, Ottawa, 1977. 8 p.

Delightful paper sculpture with directions and text in both French and English.

Porter, Jessica A., ed. Gentle Giants of the Sea. The Whale Museum (P.O. Box 1154, Friday Harbor, WA 98250), 1981.

Student text, teacher notes and activities, and 38 supplemental coloring pages for students cover whale origins, physical characteristics, life cycles, consciousness and controversies.

Pryor, Karen. Lads Before the Wind. Harper and Row, New York, 1975. 278 p.

Porpoise behavior/research results written in light, anecdotal style.

Riedman, Sarah R. and Elton T. Gustafson. Home is the Sea: For Whales. Abelard-Schuman, New York, 1971. 264 p.

Well-indexed and well-illustrated with many photographs, drawings and charts about dolphins and whales.

Robson, Frank. Thinking Dolphins, Talking Whales. Charles E. Tuttle Co., Cincinnati, 1976.

Cetacean behavior and communication with people presented for the layman. First-hand reports on rescuing stranded whales.

Roy, Ronald. A Thousand Pails of Water. Illustrated by Vo-Dinh Mai. Alfred A. Knopf, New York, 1978. 29 p.

The son of a Japanese fisherman does not understand why his father kills whales. He sets about trying to save a beached whale by keeping it wet until the tide returns. Beautiful pencil-and-wash illustrations.

Scammon, Charles M. The Marine Mammals of the Northwestern Coast of North America. 1874. Reprint. Dover, New York, 1968. 319 p.

Classic account by a skipper of whaling and sealing ships in the 1850s. Natural history of whales, seals and walruses.

Schad, Marsha C. A Field Guide to the Marine Mammals of Alaska. National Marine Fisheries Service (P.O. Box 1668, Juneau, AK 99802), July 1978.

Highly informative pamphlet, with brief descriptions and simple line drawings.

Scheffer, Victor B. Little Calf. Charles Scribner's Sons, New York, 1970. 140 p.

Adaptation of The Year of the Whale (see below) for children. Clearly written, sensitive.

Scheffer, Victor B. The Year of the Seal. Illustrated by Leonard Everett Fisher. Charles Scribner's Sons, 1970. 200 p.

Year in the life of an Alaska fur seal through perspective of author-biologist.

Scheffer, Victor B. The Year of the Whale. Illustrated by Leonard Everett Fisher. Charles Scribner's Sons, New York, 1969. 213 p.

Sympathetic account of the basic life cycle and ecology of the Pacific sperm whale.

Schultz, Charles R. Life on Board American Clipper Ships. Texas A&M University (Sea Grant Program, College Station, TX 77843), Jan. 1983.

Succinct and interesting booklet with illustrations, maps, glossary and an annotated bibliography.

Selsam, Millicent. A First Look at Whales. Illustrated by Harriett Springer. Walker and Co., New York, 1980. 32 p.

Classification, general attributes and distinguishing characteristics of whales and fish. Text and black-and-white drawings encourage observation.

Shapiro, Irwin and E.A. Stackpole. The Story of Yankee Whaling. American Heritage Publishing Co., New York, 1959.

Introduction for students to history and methods of commercial whaling. Well-illustrated with prints, paintings and sketches.

Shaw, Evelyn. Elephant Seal Island. Illustrated by Cheryl Pape. Harper and Row, New York, 1979. 62 p.

Science I Can Read book follows life of mother and son elephant seals off coast of California.

Shaw, Evelyn. Sea Otters. Illustration by Cheryl Pape. Harper and Row, New York, 1980. 64 p.

An I Can Read book on how a mother sea otter takes care of her baby pup and teaches him to be independent. Includes eating, sleeping and protection. Illustrations in blue, gold and gray of animals and their kelp-bed home.

Simon, Seymour. Killer Whales. Photographs by Betty Davis. J.B. Lippincott Co., Philadelphia, 1978. 96 p.

Comparison of killer whale behavior and survival instincts in captivity and at sea. Excellent black-and-white photographs.

Simon, Seymour, Life on Ice: How Animals Survive in the Arctic. Franklin Watts, New York, 1976. 65 p.

Survival of arctic animals despite extreme weather conditions and human threats.

Slipper, Everhard J. Whales and Dolphins. University of Michigan Press, Ann Arbor, 1962. 170 p.

Summary of information, with photographs and line drawings of cetaceans.

Small, George. The Blue Whale. Columbia University Press, New York, 1971. 29 p.

Destroys the myth of killer whales as savage hunters, with information on their intelligence and their methods of communication. Winner of the National Book Award for Science in 1971.

Spizzirri, Linda, ed. An Educational Coloring Book of Whales. Spizzirri Publishing Co., Medinah, Ill., 1981.

Full-page pictures of whales in their environments. Facing pages provide outline information.

Stackpole, Edward A. Whales and Destiny. University of Massachusetts Press, Amherst, 1972. 427 p.

A history of the North American whaling industry from 1785-1925, with emphasis on international political implications.

Stonehouse, Bernard. Animals of the Arctic; The Ecology of the Far North. Holt, Rinehart and Winston, New York, 1971. 172 p.

Story of northern ecology. More than 200 color plates of Arctic animals, past and present.

Stonehouse, Bernard. A Closer Look at Whales and Dolphins. Illustrated by Norman Weaver. Gloucester Press, New York, 1978. 32 p.

Kinds of whales, sizes and habits. Beautiful illustrations in color.

Sutton, Felix. Herman Melville's Moby Dick. Grosset and Dunlap, New York, 1956.

Adaptation of the novel for students, with illustrations and large print.

Tilton, Captain G.F. *Cap'n George Fred Himself*, Doubleday, Doran and Co., New York, 1929. 295 p.

Autobiography of the author's life at sea beginning at age 14. Describes ship owners and land sharks, "critters," and the author's walk across Alaska for the rescue of an iced-in fleet.

Tryckane, Tre. *The Whale*. Simon and Schuster, New York, 1968.

Detailed biological information on cetaceans, with illustrations and fascinating photographs. Includes a brief history of whaling and information on modern whaling.

Valencic, Joe and Robin. *The Complete Whale Watcher's Guide*. Valencic, Dana Point, Calif., 1975. 40 p.

Handy handbook on whales of California, from early concepts to present scientific classification and understanding.

Walker, Michael J. *Migrating Animals: North America's Wild Travelers*. David McKay Co., New York, 1979. 120 p.

Bird, fish and mammal migratory habits; reasons for migration and dangers encountered on the way.

Walker, Theodore J. *Whale Primer*. Cabrillo Historical Assoc., 1975. 58 p.

An introduction to whales, concentrating on the California gray whale. Illustrated with photographs.

Waters, John F. *Seal Harbor: Story of the Harbor Seal*. Frederick Warne and Co., New York, 1973. 45 p.

Tells of the relationship between a Maine boy and local seals; with detailed observations on the seals.

Waters, John F. *Some Mammals Live in the Sea*. Dodd, Mead and Co., New York, 1972. 96 p.

Clear, concise text and black-and-white photographs depict habits of sea mammals including seals, otters and dolphins.

Watson, Jane W. *Whales: Friendly Dolphins and Mighty Giants of the Sea*. Illustrated by Richard Amundsen. Western Publishing Co. Golden Books, Racine, Wis., 1975. 64 p.

Full-color illustrations add action to coverage of types of whales, their habits and vocalizations; and whaling.

Woodhouse, Kate, ed. *The Life of Sea Mammals*. Silver Burdett, New York, 1979. 61 p.

Facts and color illustrations to share with students.

Young, Jim. When the Whale Came to My Town. Photographs by Dan Bernstein. Alfred A. Knopf, New York, 1974. 36 p.

Sensitive account of a boy's discovery of a beached whale and the whale's wait for death.

Zim, Herbert S. The Great Whales. William Morrow and Co., New York, 1951. 64 p.

Children's book with basic facts about various whales. Well-illustrated.

Curricula:

Alaska Wildlife Notebook Series Teacher Activity Guide. Alaska Dept. of Fish and Game (Public Communications Section, P.O. Box 3-200, Juneau, AK 99801).

Includes the Wildlife Notebook Series, which deals with several marine mammals. Activities are primarily for junior high and high school students, but they can be adapted for elementary school children.

Amazing Animals of the Sea. National Geographic Society, Washington, D.C., 1981. 104 p. plus classroom activities folder.

Excellent color pictures with text on marine mammals. Classroom-activities folder includes puzzles and spirit masters.

Gray Whale Teaching Kit. American Cetacean Society (P.O. Box 4416, San Pedro, CA 90731).

Color filmstrip (or slides) with cassette-tape narration plus literature, activity sheets, charts, posters and vocabulary list.

ORCA Whales. Pacific Science Center/Washington Sea Grant (200 2nd Ave. N., Seattle, WA 98109).

Excellent activities for students on whale communications and many other whale topics.

Sims, Virginia, ed. Alaska Tidelines. Alaska Sea Grant, Fairbanks. "The Whales Return," Vol. I, No. 6, March 1979; "Airuk (Walrus)," Vol. II, No. 2, Oct. 1980; "What Has? (Seals)," Vol. IV, No. 2, Oct. 1981.

Sims, Virginia, ed. Alaska Earthlines/Tidelines. Alaska Geographic Society, Anchorage. "Should the Fur Seal Harvest be Halted?," Vol. V, No. 3, Nov. 1979; "The Sea Otters are Back," Vol. 5, No. 6, March 1983.

Alaska Tidelines, now Alaska Earthlines/Tidelines, is a monthly newsletter for students with excellent coverage of marine mammals and many other topics. It includes quizzes and crosswords.

Iudicello, Suzanne, ed. Alaska Fish Tales and Game Trails, Vol. XII, No. 1, Fall 1980. 47 p. Alaska Dept. of Fish and Game, Juneau.

Issue devoted to logging, fisheries and wildlife interactions.

Heller, Christine. Wild, Edible and Poisonous Plants of Alaska. Alaska Cooperative Extension Service, University of Alaska, Fairbanks, 1981 (revised). 90 p.

Handy pocket book with line drawings and color photographs of edible and poisonous species. (A slide-tape show is also available.)

Jackson, W. H. with Ethel Dassow. Handloggers. Alaska Northwest Publishing Co., Anchorage, 1974. 251 p.

The handlogging adventures of a Southeast Alaska couple in the early 1900s.

Kessler, Winifred B. Bird Population Responses to Clearcutting in the Tongass National Forest of Southeast Alaska. U.S. Dept. of Agriculture, (U.S. Forest Service, Tongass National Forest, Federal Building, Ketchikan, Alaska 99901), Alaska Region Report No. 71, Sept. 1979. 22 p.

Technical report of initial study of bird use of old growth and clearcut forests.

Schoen, John W., Olaf C. Wallmo, and Matthew D. Kirchoff. Wildlife-Forest Relationships: Is a Re-evaluation of Old Growth Necessary? Wildlife Management Institute, Washington, D.C., 1981, pp. 531-544.

Technical review of deer uses of old-growth forests, with focus on Alaska studies. Reprinted from Transactions of the 46th North American Wildlife and Natural Resources Conference.

Schoen, John W. and O.C. Wallmo. "Deer and Logging Relationships in Southeastern Alaska." Alaska Fish Tales and Game Trails, July/Aug. 1978, pp. 2-3, 10.

Results of research on deer and logging relationships. Illustrated with several photographs.

Sheridan, William, et al. Logging and Fish Habitat. U.S. Forest Service, Juneau, Alaska, 1976.

Pamphlet listing logging techniques that protect fish habitat. Illustrated with photographs.

Charts and Records:

Baffy the Sea Otter and Baleena the Blue Whale. Whale Gifts (Center for Environmental Education, 2100 M Street, N.W., Washington, DC 20037).

Tapes and accompanying 16-page children's book.

Callings. Produced by Paul Winter. Two records and booklet of photos, narrative, and background on each species.

Traces the mythic journey of a sea lion pup that encounters other marine mammals. The animal's voice mingles with winter's music.

Deep Voices: The Second Whale Record.

Includes two entirely new humpback songs, as well as right and blue whale sounds.

Marine Mammals of the Western Hemisphere. National Oceanic and Atmospheric Administration. (Available from the Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402. Stock No. 003-020-0887-8.)

Marine mammal chart with full-color scale drawings of whales, dolphins, and seals.

Ocean of Song: Whale Voices

Features a variety of unique songs, ocean waves, sea birds.

Songs of the Humpback Whales. Produced by Roger and Katy Payne. Capitol ST 620, 1970.

Classic recording of the great range and variety of humpback communications.

Whales and Nightingales. "Farewell to Tar Waithe," sung by Judy Collins, Elektra, 1970.

Haunting musical combination of whales and lyrics.

Games:

Krill: A Whale of a Game. Ampersand Press (2603 Grove St., Oakland, CA 94612).

Deck of cards for playing five different games, based on the Antarctic food chain.

Viereck, Leslie A. and Albert L. Little, Jr. Alaska Trees and Shrubs. Agriculture Handbook No. 410, U.S. Forest Service, U.S. Dept. of Agriculture, Washington, D.C., 1972. 265 p. (Also available in a condensed paperback version. Both editions can be ordered from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, DC 20402.)

Text with excellent line drawings for each species.

Woolf, Bill. Deer and Logging: A Clear-Cut Dilemma. Wildlife Information Leaflet No. 5. Alaska Dept. of Fish and Game, Juneau, Sept. 1978. 4 p.

Describes deer and logging conflicts. Graphs and photographs.

Curricula:

Alaska Women in Timber. Alaska's Great Green Forest. Alaska Women in Timber (111 Stedman Street, No. 200, Ketchikan, AK 99901), 1982.

Five-lesson educational kit with spirit masters and poster--free to all Alaska teachers. Includes brief bibliography of materials available from groups such as the American Forest Institute, 1619 Massachusetts Ave. NW, Washington, D.C. 20036; and the Alaska Loggers Association, 111 Stedman Street, No. 200, Ketchikan, AK 99901.

Anastasiou, Kip. The Stump Book. Western Education Development Group, University of British Columbia, (Vancouver, B.C. Canada V6T 1W5), 1975. 28 p.

Plenty of field and classroom activities on stumps.

Hadley, Melissa. Measuring the Forest. Western Education Development Group, University of British Columbia, (Vancouver, B.C. Canada V6T 1W5), 1978. 63 p.

Describes the process of cruising timber. Good field mathematics for students.

Julian, Helen. Southeast Alaska Forest Notebook. Helen Julian (P.O. Box 603, Thorne Bay, AK 99950), 1977. 112 p.

Activities, games and puzzles and a brief bibliography on trees, shrubs and plants of Southeast Alaska.

Knapp, Clifford E. Outdoor Activities for Environmental Studies. The Instructor Publications, (Dansville, NY 14437), 1971. 48 p.

Information on various tree measurements and hands-on suggestions for using outdoor equipment.

Sims, Virginia, ed. Alaska Earthlines/Tidelines. Alaska Geographic Society, Anchorage. "Alaska's Kooky Treeline," Vol. 6, No. 2 and "A Closer Look at Southeast Alaska's Forests," Vol. 6, No. 3. 1983. 8 p. (each). Alaska Geographic Society (Box 4-EEE, Anchorage, AK 99509).

Excellent newsletter for students; includes questions and crosswords.

UNIT 4--OIL AND OIL DEVELOPMENT

Alaska's Oil/Gas Minerals Industry. Alaska Geographic, Vol. 9, No. 4., 1982.

Lots of photographs and accompanying text about oil and gas development in Alaska.

Alaska State Energy Policy Committee. Alaska's Energy Policy: Issues and Options. Alaska State Energy Policy Committee (Pouch V, Juneau, AK 99811), 1978. 12 p.

Handy pamphlet describing past energy studies and future options.

Brown, Joseph E. Oil Spills: Danger in the Sea. Dodd, Mead and Co., New York, 1978. 124 p.

How oil spills happen, what the results to the environment are, clean-up methods, and what is being done about spills. Photographs of ships, spills and cleanup.

Kramer, L.S., V.C. Clark, and G.J. Cannelos. Planning for Offshore Oil Development: Gulf of Alaska OCS Handbook. Alaska Dept. of Community and Regional Affairs (Division of Community Planning, Juneau, AK, 99811), 1978. 257 p.

Technical paper on planning for offshore oil. Details parameters and considerations.

Laycock, George. Beyond the Arctic Circle. Four Winds Press, New York, 1978. 116 p.

Describes the arctic regions, Alaska's oil development, northern animals and life of the Eskimos.

Marx, W. Oilspill. Sierra Club Books, San Francisco, 1971.

One-sided view of the problems associated with oil in marine environments.

Curricula:

Sims, Virginia, ed. Alaska Tidelines. Alaska Geographic Society, Anchorage. "Under the Oil Rig Christmas Tree," Vol. IV, No. 4 Dec./Jan. 1981/82 and "Alaska's Oil Wealth," Vol IV, No. 5, Feb. 1982.

Whole issues of this excellent student newspaper are devoted to oil production and uses.

UNIT 5 - COMMUNITY PLANNING ALONG OUR COASTS AND RIVERS

Alaska Currently State of Alaska, Office of Coastal Management (Planning Section, Pouch AP, Juneau, AK 99811).

A newsletter dealing with Alaska's coastal issues.

Alaska's Energy Policy: Issues and Options. Alaska State Energy Policy Committee (Pouch V, Juneau, AK 99811), 1978, 12 p.

Handy pamphlet describing past energy studies and future options.

Amos, William H. The Life of the Pond. McGraw-Hill Book Co., New York, 1967. 232 p.

Comprehensive photographic reference on ponds and their plant and animal life.

Angel, Heather. The World of an Estuary. Faber and Faber, Salem, N.H., 1974. 128 p.

Description and definition of an estuary, its plants and animals and their interactions.

Buck, Lewis. Wetlands, Bogs, Marshes and Swamps. Parents' Magazine Press, New York, 1974. 64 p.

Explains how bogs, marshes and swamps develop, clarifies the differences among them and their interrelationships. Biology and ecology presented in a simple, straightforward manner.

Burman, Ben Lucien. High Water at Catfish Bend. Illustrated by Alice Caddy. Puffin Books, New York, 1977. 123 p.

Story of cooperation and unselfishness on the part of five animals who unite to do something about the way humans are managing floods on their floodplain home.

Couffer, Jack and Mike. Salt Marsh Summer. G.P. Putnam's Sons, New York, 1978. 90 p.

Conservationist text describes a salt marsh present and past--when the father was the current age of his teen-age son. Beautiful photographs.

Goldin, Augusta. Oceans of Energy: Reservoir or Power for the Future. Harcourt Brace Jovanovich, New York, 1980. 199 p.

Careful explanations of the six different kinds of energy from our oceans that can be converted to electricity or gas. Present status and predictions for the future.

Gray, T.J. and O.K. Gaghus. *Tidal Power*. Plenum Press, 1972.

Twenty-six articles of varied complexity on tidal-power generation schemes. Good discussion of a planned installation in Cook Inlet.

Horwitz, E.L. *Our Nations Wetlands*. An Interagency Task Force Report, 1978. 70 p. (Available from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, DC 20402 Stock No. 041-011-0045-9.)

Describes various types of wetlands and their importance nationally. Many photographs and drawings.

Iker, S. "Look What We've Done to Our Wetlands." *National Wildlife*, Vol. 20, June-July 1982. 4 p.

Describes wetlands importance and losses nationwide. Color photographs.

Merrill, Richard and Thomas Gage, eds. *Energy Primer: Solar, Water, Wind, and Biofuels* (Updated and Revised Edition). Dell Publishing Co., New York, 1978. 256 p.

Packed full of information in the style of the Last Whole Earth Catalog.

Niering, W.A. *The Life of the Marsh*. Our Living World of Nature series. Published in cooperation with the World Book Encyclopedia. McGraw-Hill Book Co., New York, 1966. 232 p.

Stresses ecological relationships. Color photographs and fine-line drawings.

Pringle, Lawrence. *Ecology, Science of Survival*. MacMillan Co., New York, 1971. 148 p.

Fine introduction to ecology, including energy flow and life cycles, oceans, estuaries, rivers, streams, lakes and ponds. Stresses importance of studying ecology.

Salken, L.D. *Estuary: What a Crazy Place*. National Wildlife Federation (Washington, DC 20036), 1972. 19 p.

Pamphlet explaining the importance of estuaries.

Stern, Cecily. *A Different Kind of Gold*. Harper and Row, New York, 1981.

A ten-year-old girl's summer in a southeastern Alaska cove--kayaking, raising seals and battling plans to develop a large resort nearby.

Stonehouse, Bernard. Animals of the Arctic: The Ecology of the Far North. Holt, Rinehart and Winston, New York, 1971. 172 p.

Examines the ecology of northern regions, which should be understood in discussing far north development plans. Maps and color plates enhance presentation.

Teal, J. and M. Life and Death of the Salt Marsh. Ballantine Books, New York, 1969. 274 p.

Tells the past and present history of East Coast marshes in a novel-like style. Good background on the importance of wetlands and their ecology.

Environmental Education Report. American Society for Environmental Education (P.O. Box R, Durham, NH 03824), Feb/Mar 1982. 18 p.

Entire issue devoted to the wetlands controversy. Excellent articles with plenty of background facts and figures.

Curricula:

Energy Conservation Activity Packets. Iowa Dept. of Public Instruction (Grimes Building, Des Moines, IA 50319), 1980.

Activity-oriented curriculum in five volumes (k-2,3,4,5,6) offers several lessons to exemplify each of the energy objectives outlined for grades K-6. Includes extensive, annotated bibliography.

Energy, Food and You. Washington Office of Environmental Education (2000 N.E. Perkins Way, Seattle, WA 98155), 1979. (2 volumes: K-8, 9-12)

Excellent activities on global food and resource issues, energy and the U.S. food system, and energy-efficient nutrition.

Science Activities in Energy. U.S. Dept. of Energy (Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830).

Electrical, chemical, biomass, conservation, solar and wind packets with directions for simple experiments.

Sims, Virginia, ed. "Energy." Alaska Tidelines Vol. II, No. 1, Sept. 1980. Alaska Sea Grant, Fairbanks.

Sims, Virginia, ed. "Nature's Water Wheel." Alaska Earthlines/Tidelines Vol. V, No. 7, April 1983. Alaska Geographic Society, Anchorage.

Student newsletter with comprehensive treatment of energy issues.

UNIT 6--WEATHER

Andrews, William A. ed. A Guide to the Study of Freshwater Ecology. Prentice-Hall, Englewood Cliffs, N.J., 1972. 182 p.

Excellent discussion of basic ecological principles, augmented by chapters on field studies, laboratory studies, and case studies.

George, Jean C. Who Really Killed Cock Robin? An Ecological Mystery. E.P. Dutton, New York, 1971. 149 p.

Two friends investigate the death of a robin, finding water and soil pollution.

Hicks, Clifford B. Alvin Fernald, Super Weasel. Holt, Rinehart and Winston, New York, 1974. 160 p.

Another victory over pollution by great brain Fernald and his army of friends.

Hillcourt, William. The New Field Book of Nature Activities and Hobbies. Putnam and Co., New York, 1970 (revised). 400 p.

A thorough guide replete with illustrations, maps and good information.

Jones, Claire, Steve Calder and Paul Engstrom. Pollution: The Waters of the Earth. Lerner Publications Co., Minneapolis, 1971. 95 p.

Describes major types of pollution in water systems. Case studies include Lake Erie, the Cuyahoga River, the Mississippi, Florida's Gulf Coast, and the Columbia River.

Lehr, Paul, E. R. Will Burnett and Herbert S. Zim. Weather. Golden Nature Guide. Golden Press, New York, 1957. 160 p.

Typical pocket golden guide packed with information and color illustrations.

Pringle, Lawrence. This is a River: Exploring an Ecosystem. MacMillan Co., New York, 1972. 55 p.

Diagram illustrates types of life present in water in relation to the amount and location of industrial pollution.

Renn, Charles E. Our Environment Battles Water Pollution. LaMotte Chemical Products Co., Chestertown, Maryland, 1969. 32 p.

Causes of and biological responses to water pollution, explained in a succinct manner.

Sloane, Eric. How You Can Forecast the Weather. Fawcett Publications, New York, 1957. 144 p.

Fascinating exploration of the forces that shape our weather. Tells how to forecast the weather in a readable style, with excellent charts and drawings.

Soutin, Harry. Easy Experiments with Water Pollution. Illustrated by Lucy Bitzer, Four Winds Press, New York, 1974. 112 p.

Background information on pollution; explanations of water-quality tests. Drawings and diagrams.

Weather. Merit Badge series. Boy Scouts of America, New Brunswick, N.J., 1963. 58 p.

Weather basics and ideas for experiments, illustrated with graphs and drawings.

Wilson, Francis and Felicity Mansfield. Spotter's Guide to the Weather. Mayflower Books, New York, 1979. 64 p.

Beautifully produced and illustrated pocket guide to weather.

Curricula:

Air Quality in Anchorage and Fairbanks and Safe Drinking Water in Alaska. Dept. of Environmental Conservation (Pouch O, Juneau, AK 99811).

Two curricula developed for K-12 students, with lots of background information and worksheets.

Living with the Weather. Weekly Reader/Secondary Unit Books (1250 Fairwood Avenue, P.O. Box 16618, Columbus, OH 43216).

An up-to-date secondary science unit with teacher's guide. Gives basics about weather, climate, air pollution and weather interactions, with photographs, drawings and diagrams. (Also available from same publishers is an Oceans unit.)

Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509.

Plenty of good information about Alaska's seas, rivers and wetlands is packed into these photo-filled issues of Alaska Geographic.

Vol. 1, No. 1 - The North Slope (out of print)
Vol. 1, No. 3 - Admiralty, Island in Contention
Vol. 1, No. 4 - Ascent from Fisheries of the North Pacific: History, Species, Gear and Processes (out of print, but book version available)
Vol. 2, No. 1 - The Alaska-Yukon Wild Flowers Guide
Vol. 2, No. 3 - Prince William Sound (out of print)
Vol. 2, No. 4 - Yakutat: The Turbulent Crescent (out of print)

Vol. 3, No. 1 - Glacier Bay: Old Ice, New Land
Vol. 3, No. 4 - The Silver Years of the Alaska Canned Salmon Industry: An Album of Historical Photos (out of print)
Vol. 4, No. 3 - Kodiak: Island of Change (out of print)
Vol. 5, No. 1 - Cook Inlet Country (out of print)
Vol. 5, No. 2 - Southeast: Alaska's Panhandle
Vol. 5, No. 3 - Bristol Bay Basin (out of print)
Vol. 5, No. 4 - Alaska Whales and Whaling
Vol. 6, No. 1 - Yukon Kuskokwim Delta (out of print)
Vol. 6, No. 3 - Alaska's Native People
Vol. 6, No. 4 - The Stikine River
Vol. 7, No. 1 - Alaska's Great Interior
Vol. 7, No. 2 - A Photographic Geography of Alaska
Vol. 7. No. 3 - The Aleutians
Vol. 8, No. 2 - Alaska Mammals
Vol. 8, No. 3 - The Kotzebue Basin
Vol. 9, No. 1 - Alaska's Glaciers
Vol. 9, No. 2 - Sitka and Its Ocean/Island World
Vol. 9, No. 3 - Islands of the Seals: The Pribilofs
Vol. 9, No. 4 - Alaska's Oil/Gas Minerals Industry
Vol. 10, No. 2 - Anchorage and the Cook Inlet Basin
Vol. 10, No. 3 - Alaska's Salmon Fisheries
Vol. 10, No. 4 - Up the Koyukuk

Alaska Wildlife Notebook Series. Public Communications Section, Alaska Dept. of Fish and Game (P.O. Box 3-2000, Juneau, AK 99801). (free)

Series of one-page sheets on fish and other animal species. Excellent line drawings and range maps.

Abbott, R. Tucker. Seashells of North America. Golden Field Guide series. Golden Press, New York, 1968. 280 p.

Describes shell species for identification with text and color drawings. Includes general background information on shells.

Armstrong, Robert. A Guide to the Birds of Alaska. Alaska Northwest Publishing Co., Anchorage, 1980. 309 p.

Species descriptions and range information on Alaska birds. Color photographs.

Barr, Lou and Nancy. Under Alaskan Seas: The Shallow Water Marine Invertebrates. Alaska Northwest Publishing Co., Anchorage, 1983. 208 p.

Specific to Alaska waters, this book is the perfect complement to the Sea Week Curriculum Series. Its excellent photographs are supplemented by text that includes species descriptions, ranges and natural history.

Berrill, N.J. and Jacquelyn Berrill. 1001 Questions Answered About the Seashore. Dover Publications, New York, 1957. 305 p.

Page after page of question-and-answer format information about the beach and sea, with photographs and drawings.

Brindze, Ruth. The Rise and Fall of the Seas: The Story of Tides. Illustrated by Felix Cooper. Harcourt, Brace and World, New York, 1964. 91 p.

Introduces causes, effects, dangers and uses of tides. Black-and-white photographs and diagrams augment explanations.

Burt, W.H. A Field Guide to the Mammals. Peterson Field Guide Series No. 5. Houghton Mifflin Co., Boston, 1964. 284 p.

Excellent descriptions, pictures and range maps of mammal species found north of Mexico.

Carr, Marion B. Oceanography. Illustrated by Sy Barlowe. Golden Press, West Publishing Co., Racine, Wisconsin, 1973. 48 p.

A pocket handbook of oceanographic basics.

Clemons, Elizabeth. Tide Pools and Beaches. Illustrated by Joe Gault. Alfred A. Knopf, New York, 1964. 79 p.

Common-name identification, scientific names and habitat of seashore organisms. Illustrated with simple line drawings.

Crowley, Walt. The Seattle Aquarium Guide to Life in the Sea. Seattle Aquarium, Seattle, 1981. 79 p.

Ecological relationships and scientific concepts explained, using color photographs and drawings.

Ellis, Annabel. *The Unknown Ocean.* Illustrated by Robert Effers. Science Explorers series G.P. Putnam, New York, 1959. 72 p.

Research presented on beaches, sea stars, mammals and interrelationships in the ocean. One of the Science Explorers series. Handsomely illustrated.

Engel, Leonard. *The Sea*. Time-Life Books, New York, 1970. 128 p.

Reference on ocean floor, current, tides, waves, sea life, man and the sea. Attractive color illustrations.

Holling, Holling Clancy. *Pagoo*. Houghton Mifflin Co., Boston, 1957. 87 p.

Engrossing story of Pagoo the hermit crab's life and adventures. Beautiful illustrations and accurate information about Pagoo and his marine neighbors.

Hoyt, John H. *Field Guide to Beaches*. Houghton Mifflin Co., Boston, 1971. 46 p.

Discusses tides, currents, sand and beach geology. Line drawings.

Jacobson, Morris K. and David R. Franz. *Wonders of Jellyfish*. Dodd, Mead and Co., New York, 1978. 80 p.

Factual information on interesting traits, food habits, role in web of life, reproductive methods, human interest tales and uses. Includes research on antidotes to stings.

Kellin, Sally Moffet. *A Book of Snails*. Young Scott Books, New York, 1968. 47 p.

Describes physical characteristics, life cycles, habits, and snail's relationships with plants. Exotic snail pest potential introduced. Excellent photographs.

Limberg, Peter R. *102 Questions and Answers About the Sea*. Julian Messner, New York, 1975. 128 p.

Questions answered about the sea, its make-up and life forms.

MacGinitie, G.E. and N. MacGinitie. *Natural History of Marine Animals*. McGraw-HillBook Co., New York, 1949.

Engagingly written college text on West Coast invertebrates and their ecology. Full of interesting facts.

Miller, Robert C. *The Sea*. Random House, New York, 1966. 315 p.

Adult reference with many pictures.

Monroe, Alexander. A Children's Guide to the Seashore: Barnacle and His Friends. Monroe Publications (P.O. Box 397, Sudbury, MA 01776), 1979. 40 p.

Barnacle, a cartoon character, introduces the young reader to shells and other marine invertebrates. Set on the East Coast, but includes many invertebrates that also live in Alaska. Numerous line drawings.

Morris, Robert H. Donald P. Abbott and Eugene Haderlis, ed. Intertidal Invertebrates of California. Stanford University Press, Stanford. 1980. 690 p.

Encyclopedic coverage of marine invertebrates of Pacific waters. Thirty-three scientists writing on their specialities. Nearly 1,000 photographs of marine habitats, animals and anatomical details.

Murie, Olaus J. A Field Guide to Animal Tracks. Peterson Field Guide Series No. 9. Houghton Mifflin Co., Boston, 1975. 375 p.

Describes tracks and other animal signs. Many of the fascinating stories happen in Alaska. Line drawing illustrations.

Niering, W.A. The Life of the Marsh. Our Living World of Nature series. Published in cooperation with the World Book Encyclopedia. McGraw-Hill Book Co., 1966. 232 p.

Stresses ecological relationships. Color photographs and fine-line drawings.

Niesen, Thomas M. The Marine Biology Coloring Book. Illustrated by Wynn Kupit and Louren Hanson. Barnes and Noble Books, Harper and Row, New York, 1982.

Ninety-six detailed plates illustrate marine biology concepts and structure of marine life. Text gives in-depth coverage of marine biology.

Reid, G.K. Pondlife. Golden Nature Guide series. Golden Press, New York, 1967. 160 p.

The best simplified guide to life in and around ponds and streams. Packed with color drawings.

Robinson, Gayle. Beach Animals. Erco (P.O. Box 91648, Tacoma, WA 98491), 1974. 27 p.

Handy pocket picture book of Pacific Northwest marine invertebrates, written especially for elementary school teachers.

Scharff, Robert. *The How and Why Wonder Book of Oceanography*. Grosset and Dunlap, New York, 1964. 48 p.

Ocean waves, geology, currents, sea life covered in question and answer format.

Schultz, Gwen. *Icebergs and Their Voyages*. William Morrow and Co., New York, 1975. 92 p.

Easy-to-read discussion of the history, formation, location and possible uses of icebergs.

Selsam, Millicent E. and Hunt, Joyce. *A First Look at Animals without Backbones*. Illustrated by Harriet Springer. Walker and Co., New York, 1976. 32 p.

Delineates vertebrates and the major groups of invertebrates in clear and simple manner. Emphasis on observation skills.

Selsam, Millicent E. *Underwater Zoos*. Illustrated by Kathleen Elgin. William Morrow and Co., New York, 1961. 96 p.

Instructions for building and maintaining fresh and saltwater aquariums. Simple drawings.

Sims, Virginia, ed. *Alaska Earthlines/Tidelines*. Alaska Geographic Society, (Box 4-EEE, Anchorage, Alaska 99509).

This monthly (8 times/year) student newsletter is packed with information about Alaska's seas, rivers and wetlands. It was published as *Alaska Tidelines* by Alaska Sea Grant for its first three years and is now published by the Alaska Geographic Society. An excellent classroom resource.

Vol. I, No. 1 - Aquaculture
Vol. I, No. 2 - Does Alaska Have a Monster?
Vol. I, No. 3 - Alaska Tides
Vol. I, No. 4 - Winter Water
Vol. I, No. 5 - Wanted (Pink Shrimp)
Vol. I, No. 6 - The Whales Return
Vol. I. No. 7 - Millions and Millions (Clams)
Vol. I. No. 8 - Here They Come (Birds)
Vol. II, No. 1 - To Catch a Salmon
Vol. II, No. 2 - Octopus - Terror or Treat
Vol. II, No. 3 - Should the Fur Seal Harvest be Halted?
Vol. II, No. 4 - The Great Arctic Ice Machine
Vol. II, No. 5 - Alaska's Scariest Fishery (Crabs)
Vol. II, No. 6 - Presenting the Impossible Puffin
Vol. II, No. 7 - Spring Comes to the Sea
Vol. II, No. 8 - How to Survive on a Beach
Vol. III, No. 1 - Energy
Vol. III, No. 2 - Aivuk (Walrus)
Vol. III, No. 3 - The Port that Grew in the Wrong Place

Vol. III, No. 4 - Mystery of the Boulder Patch
Vol. III, No. 5 - What's that Funny Looking Fish?
Vol. III, No. 6 - Great Wave in Harbor
Vol. III, No. 7 - The Herring Bonanza
Vol. III, No. 8 - Things that Bite and Sting
Vol. IV, No. 1 - How to Take Care of Your Catch
Vol. IV, No. 2 - What Has? (Seals)
Vol. IV, No. 3 - Alaska's Restless Glaciers
Vol. IV, No. 4 - Under the Oil Rig $ Christmas Tree
Vol. IV, No. 5 - Alaska's Oil Wealth
Vol. IV, No. 6 - The Old Woman (Halibut)
Vol. IV, No. 7 - Zoom IN (Transect)
Vol. IV, No. 8 - The New Alaska Gold Rush
Vol. V, No. 1 - Is Alaska Warming Up?
Vol. V, No. 2 - Meet Alaska's Monstrous Moose
Vol. V, No. 5 - Run the Iditarod
Vol. V, No. 6 - The Sea Otters are Back
Vol. V, No. 7 - Natures Water Wheel
Vol. V, No. 8 - What'll I Do This Summer?
Vol. VI, No. 1 - Bering Sea--Mystery and Magic
Vol. VI, No. 2 - Alaska's Kooky Treeline
Vol. VI, No. 3 - A Closer Look at Southeast Alaska's Forests
Vol. VI, No. 5 - Our Northern Link in the 'Ring of Fire'
Vol. VI, No. 6 - Cattle of the Tundra
Vol. VI, No. 7 - Eyes in the Sky
Vol. VI, No. 8 - Stones and Bones

Smith, L.S. Living Shores of the Pacific Northwest. Pacific Search Press, Seattle, 1976. 149 p.

Description of marine shore habitats and their inhabitants. Color and black-and-white photographs. Includes a simple picture key and tables showing intertidal distribution of the different species.

Snively, Gloria. Exploring the Seashore in British Columbia, Washington and Oregon: A Guide to Shorebirds and Intertidal Plants and Animals. The Writing Works, Mercer Island, Wash., 1978. 240 p.

Describes a variety of seashore organisms organized by habitat. Line drawings and color photographs.

Snow, John O. Secrets of Ponds and Lakes. Guy Garrett Publishing Co., Portland, Maine, 1982. 94 p.

Interesting facts and stories written for the East Coast but also applicable to Alaska. Author an avid naturalist and high school biology teacher. Line drawings and black-and-white photographs.

Updegraff, Imelda and Robert. Seas and Oceans. Penguin Books, (Puffin), New York, 1980. 24 p.

Explains basic concepts of seas, oceans and sea ice. Large print on colorful pages. Gives worldwide examples and includes a few activity ideas.

Usinger, Robert L. The Life of Rivers and Streams. Our Living World of Nature series. Published in cooperation with the World Book Encyclopedia. McGraw-Hill Book Co., 1967. 232 p.

Stresses ecological relationships. Color photographs and fine-line drawings.

Verite, Marcelle. Animals of the Sea. Illustrated by Romain Simon. Childrens Press, Chicago, 1964. 63 p.

Twenty-five sections present worldwide marine animals from the Sargasso Sea to the Great Barrier Reef to the Galapagos Islands. Brilliantly illustrated translation of French book.

Vevers, Gwynne. Life in the Sea. Illustrated by Barry Driscoll. McGraw-Hill Book Co., New York, San Francisco, 1965. 32 p.

Short, illustrated discussions on such topics as tides, pools, shores, marine animals, food chains, diving and aquariums.

Voss, Gilbert L. Oceanography. Golden Press, New York, 1972. 160 p.

Mini encyclopedia on ocean subjects.

Waaland, J.R. Common Seaweeds of the Pacific Coast. Pacific Search Press, Seattle, 1977. 120 p.

Species descriptions with full-page illustrations.

Zim, Herbert S. Waves. William Morrow and Co., New York, 1967. 64 p.

Topics covered in this easy-reading guide include waves, the effects of waves on beaches, and tsunamis.

Zim, Herbert S. and Lester Ingle. Seashores. Golden Pocket Guide series. Golden Press, New York, 1955. 160 p.

Handbook for exploring the ecology of any shore. Classification charts and color illustrations aid in identification.

Recordings:

Sounds of the Sea. #3 of Droll Yankees Seaport Series. 33 RPM, LP by Droll Yankees, 1962.

Sea sounds from boats and ports, wind and waves.

UNIT 8--SEA WEEK CAMP

Arasaki, Seibin and Teruko. Low Calorie High Nutrition Vegetables From the Sea to Help You Look and Feel Better. Japan Publications, Tokyo, 1983. 196 p.

Tremendous resource describing nutrition, uses, biology, harvesting, farming, processing and preserving of seaweeds, with many recipes. Illustrated with line drawings and a few color plates.

Ayotte, Ellen and Marguerite Stetson, ed. Collecting and Using Alaska's Wild Berries and Other Wild Products. Cooperative Extension Service, University of Alaska, Fairbanks, 1980. 34 p.

Pictures, descriptions, recipes and nutritional information for wild berries.

Cold Water Drowning. United States Coast Guard and Michigan Sea Grant. (USGS Bosteam 17, P.O. Box 2471, Anchorage, AK 99510).

Pamphlet explaining cold water near-drowning rescue techniques.

Cold Weather Survival. Alaska Dept. of Fish and Game (Hunter Education Program, 333 Raspberry Road, Anchorage, AK 99502) (reprinted with permission of Alaska Oil and Gas Assoc.). 42 p.

Good tips for surviving the cold.

Fortier, Ed. One Survived. Alaska Northwest Publishing Co., Anchorage, 1978. 41 p.

The incredible story of a King Island Eskimo who survived 18 days in wintertime Alaska--much of the time adrift on the ice.

Furlong, M. and V. Pill. Edible? Incredible! Pondlife. Naturegraph Publishers, Happy Camps, Calif., 1972.

Photographs and text describes pondlife and how to prepare it as food. Helpful hints on where to find species.

Heller, Christine. Wild Edible and Poisonous Plants of Alaska. Cooperative Extension Service, University of Alaska, Fairbanks, 1981 (revised). 90 p.

Handy pocket book with line drawings and color photographs of edible and poisonous species. (A slide-tape show is also available.)

Kavaler, Lucy. Life Battles Cold. John Day Co., New York, 1973. 160 p.

Survival information as well as research on hibernation and on adaptations of animals, microbes and humans to cold climates.

McKinlay, William Laird. Karluk. New American Library, New York, 1976. 222 p.

The incredible story of a survivor of the ill-planned and ill-prepared arctic exploration voyage of the Karluk, trapped in the ice off the northern Alaska coast.

National Fisherman Yearbook Issue 1982, Vol. 62, No. 13. Camdem, Maine. 192 p.

Entire issue devoted to "Survival at Sea."

O'Dell, Scott. Island of the Blue Dolphin. Houghton Mifflin Co., Boston, 1960. 184 p.

Natives of island removed to preserve it for Aleut otter hunters. One 12-year-old girl remains alone fighting wild dogs and a giant octopus, and surviving through self-reliance and resolve.

Peyton, K.M. Sea Fever. Collins World, Cleveland, 1963. 240 p.

Adventure at sea. Deals with life, growth and feelings.

Simon, Seymour. Life on Ice: How Animals Survive in the Arctic. Franklin Watts, New York, 1976. 65 p.

Adaptation of plants and animals to extreme weather conditions and to human threats.

Snoderly, Jim. "Abandon Ship! Wait While I Read the Instructions." Alaska Seas and Coasts, Vol. 9, No. 3, June/September 1981. p. 1-3.

Short article on life rafts, including actual experiences by a certified life-raft packer and instructor.

Stevenson, Robert L. Treasure Island. Dalton, New York, 1977.

Sea adventure classic.

United States Coast Guard. First Aid for the Boatman. (USCG Bosteam 17, P.O. Box 2471, Anchorage, AK 99510).

Pamphlet describing first-aid techniques.

Wyss, Johann. The Swiss Family Robinson. Illustrated by David Gentlemen. Heritage Press, New York, 1963. 356 p.

Classic story of survival on a deserted island. Family is marooned and becomes entirely self-sufficient.

Boating Tips for Sportsmen. United States Coast Guard. (USGS Bosteam 17 (P.O. Box 2471, Anchorage, AK 99510).

Pamphlet giving basic boating safety tips.

Student Activity

Sheets

Community Resource Inventory

1A

I. History

a. When was your community founded? ____________________

b. Who founded it? ____________________________________

c. Why was it settled? ________________________________

____

d. How did original settlers make a living? ____________

____

e. What are some things that have happened as your community has grown larger or smaller?

____

____

____

____

f. What are some reasons for its growth or shrinkage?

____

____

____

II. Population

a. What was your population 100 years ago? ______________

75 years ago? ______________

50 years ago? ______________

40 years ago? ______________

30 years ago? ______________

20 years ago? ______________

10 years ago? ______________

b. What is your population predicted to be in the future

10 years from now? ____________________

20 years from now? ____________________

30 years from now? ____________________

40 years from now? ____________________

50 years from now? ____________________

100 years from now? ____________________

c. What developments do these future population estimates depend on?

____

____

____

____

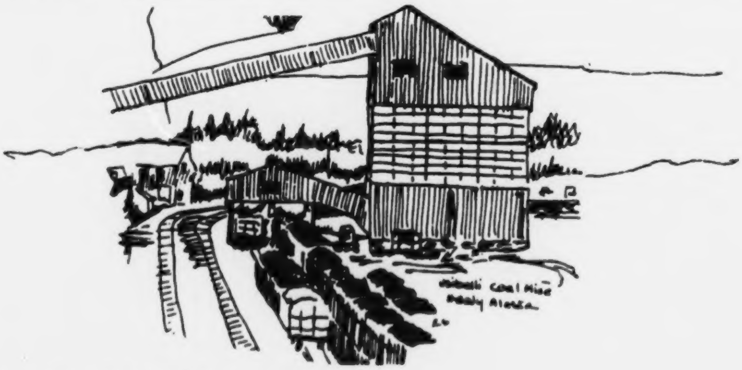
III. Natural Resources

Does your community have...

a. agricultural land? ________________________________

b. timber? ____

c. minerals? ____



d. sand and gravel? __________________________________

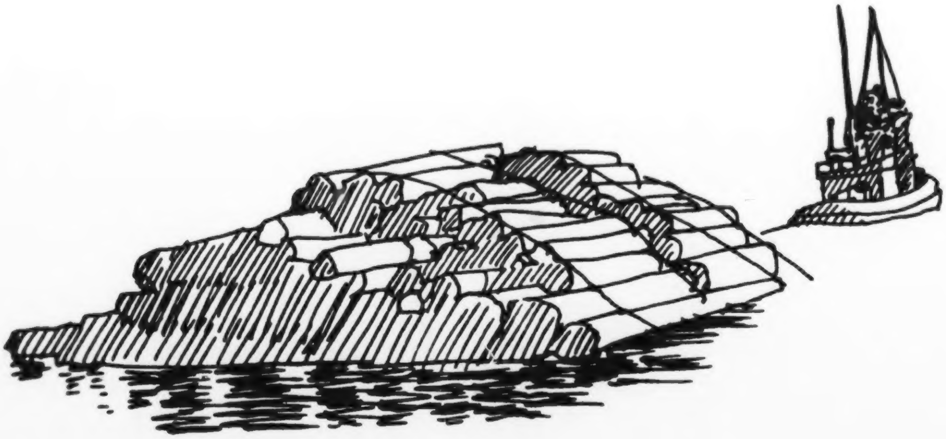
e. intertidal life? __________________________________

f. wetlands? ____

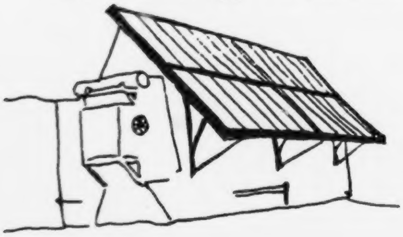
g. natural transportation opportunities (such as ocean, rivers, harbors, mountain passes, lakes, etc.)?

____

h. water resources for _____ households?
_____ electric power?
_____ aquaculture?
_____ industry?
_____ public safety?



i. energy resources



_____ wind?
_____ sun?
_____ water?
_____ coal?
_____ oil?
_____ gas?
_____ tidal power?
_____ geothermal?
_____ wood?

j. game animals? ____

____

k. non-game animals? ____

____

l. birds? ____

____

m. fish? ____________________

____

n. shellfish? ____________________

____

IV. Community Resources

Does your community have...

a. historic and archeology sites? ____________________

____

b. cultural events (festivals, dances, concerts, art shows, museums)? ____________________

____

c. public buildings (schools, meeting halls, government offices, hospitals, libraries, aquarium)?

____

d. transportation (roads, trails, floats, docks, airports, railroads)?

____

____

e. private business (hotels, stores, repair shops, contractors)?

____

____

____

f. recreational areas (gyms, a swimming pool, trail systems, parks, playgrounds)? ____________________

____

g. residences? ____________________

____

____

V. Economic Resources

Does your community have...

a. manufacturing plants? ______________________________

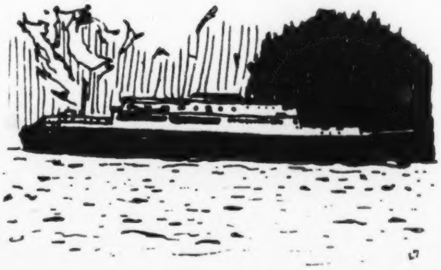
____

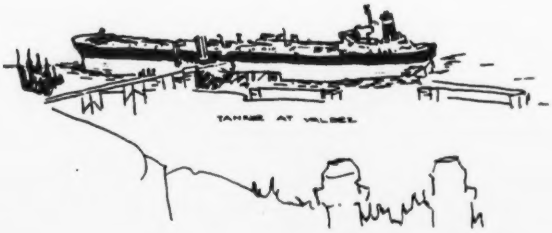
b. tourism? ______________________________

____

c. transportation facilities? ______________________________

____





d. food processing? ______________________________

____

e. government agencies? ______________________________

____

f. other industries? ______________________________

____

VI. Human Resources

Does your community have...

a. artists? ______________________________

____

b. musicians? ______________________________

____

1A

c. journalists, writers, storytellers and photographers?

____

d. government officials? ________________________

____

e. scientists? ________________________________

____

f. mechanics? ________________________________

____

g. carpenters? ________________________________

____

h. public health officials (physicians, nurses, dentists)?

____

i. businessmen and women? ______________________

____

j. recreation workers? ________________________

____

k. police and fire fighters? ____________________

____

l. transportation workers (pilots, ticket sellers, bus drivers)? ________________________

____

m. teachers? ________________________________

____

n. fishers, hunters? __________________________

____

o. other? __________________________________

____

Community Objectives Inventory

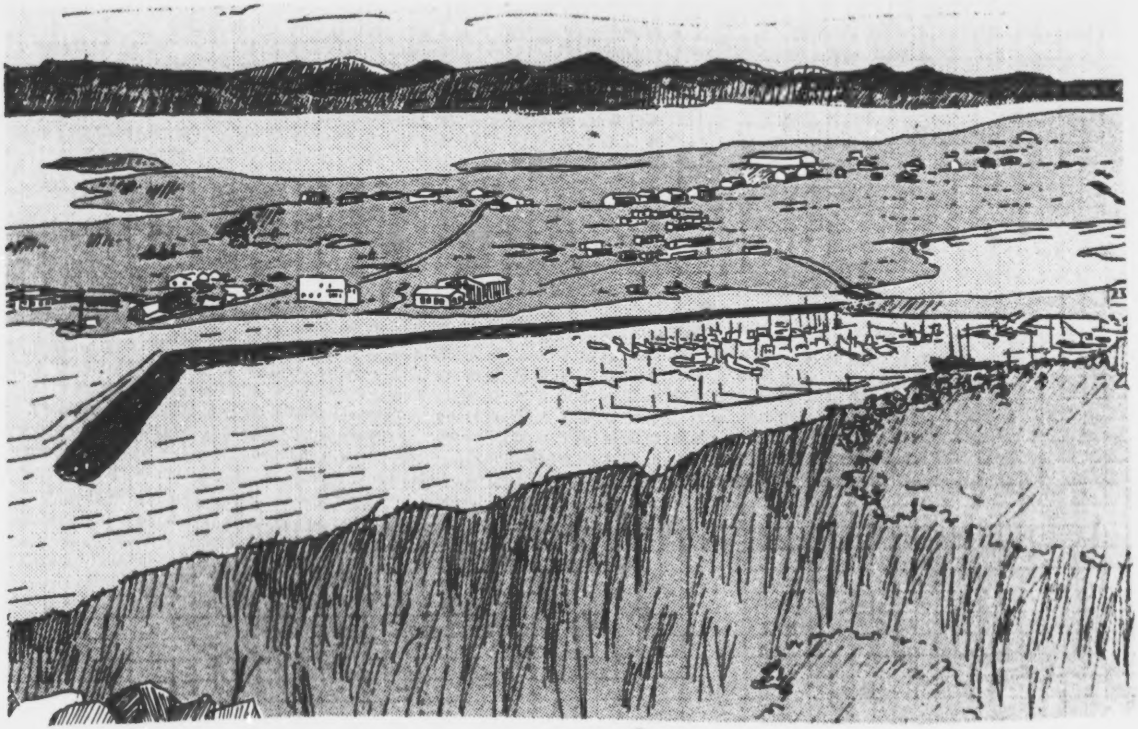
1B

Does your community want to...

		CLASS	COMPREHENSIVE PLAN
a.	improve sport fishing?		
	commercial fishing?		
	subsistence fishing?		
b.	harvest timber?		
	firewood?		
c.	mine minerals?		
d.	develop wind power?		
	solar power?		
	hydro power?		
	coal?		
	oil?		
	gas?		
	wood?		
	tidal power?		
	geothermal?		
e.	increase number of housing units?		
	number of businesses?		
	amount of industry?		
f.	promote tourism?		
g.	improve roads?		
h.	improve schools?		
i.	improve playgrounds?		
j.	add more parks?		
k.	improve local trails?		
l.	add additional recreation facilities?		
m.	build a swimming pool?		
n.	improve the harbor?		
o.	preserve beach and recreational uses?		

1B

		CLASS	COMPREHENSIVE PLAN
p.	enhance fish, game, and bird populations?		
q.	protect wildlife habitat?		
r.	build sewers?		
s.	improve the water supply?		
t.	expand the dump?		
u.	build sidewalks?		
	bike trails?		
	hiking trails?		
	ski trails?		
v.	create a museum?		
	aquarium?		
w.	have a concert?		
	art show?		
	community sing along?		



Alaska Borough Map

1C

BACKGROUND INFORMATION

1. The selected land and Yakataga City are in the coastal zone and surrounded by national forest land.

2. There is a shortage of available land due to federal land ownership, terrain, and natural hazards.

3. Yakataga City's population is 2,500 and increasing, creating a demand for housing, jobs, additional services and recreation areas.

4. Forty percent of Yakataga City's population depends primarily on fishing for its livelihood. Thirty percent of the population is unemployed during the winter.

5. Yakataga City gets its energy from a diesel-powered generator. Energy costs are extremely high.

6. The Chinook River is a salmon stream, it is navigable for power boats but not ships, and it supplies adequate water for Yakataga City. Chinook Bay is a productive estuary.

7. Citizens of Yakataga City are interested in maintaining a scenic regional environment.

8. The abandoned cannery qualifies as a historic site, but has not been classified as one. Two archeological sites are situated on adjacent Native land at Clam Neck and Mummy Island.

9. Raw sewage enters the ocean through outfalls, and solid waste disposal is an increasing problem.

10. Sand and gravel are available from along the Chinook River, but presently it is not being commercially removed.

11. Prior Forest Service management of the selected land and Native lands was as roadless backcountry, with emphasis on wildlife habitat and recreation. Adjacent national forest land will continue to be similarly managed.

12. The nearest airport is 30 miles away in Red Dog City.

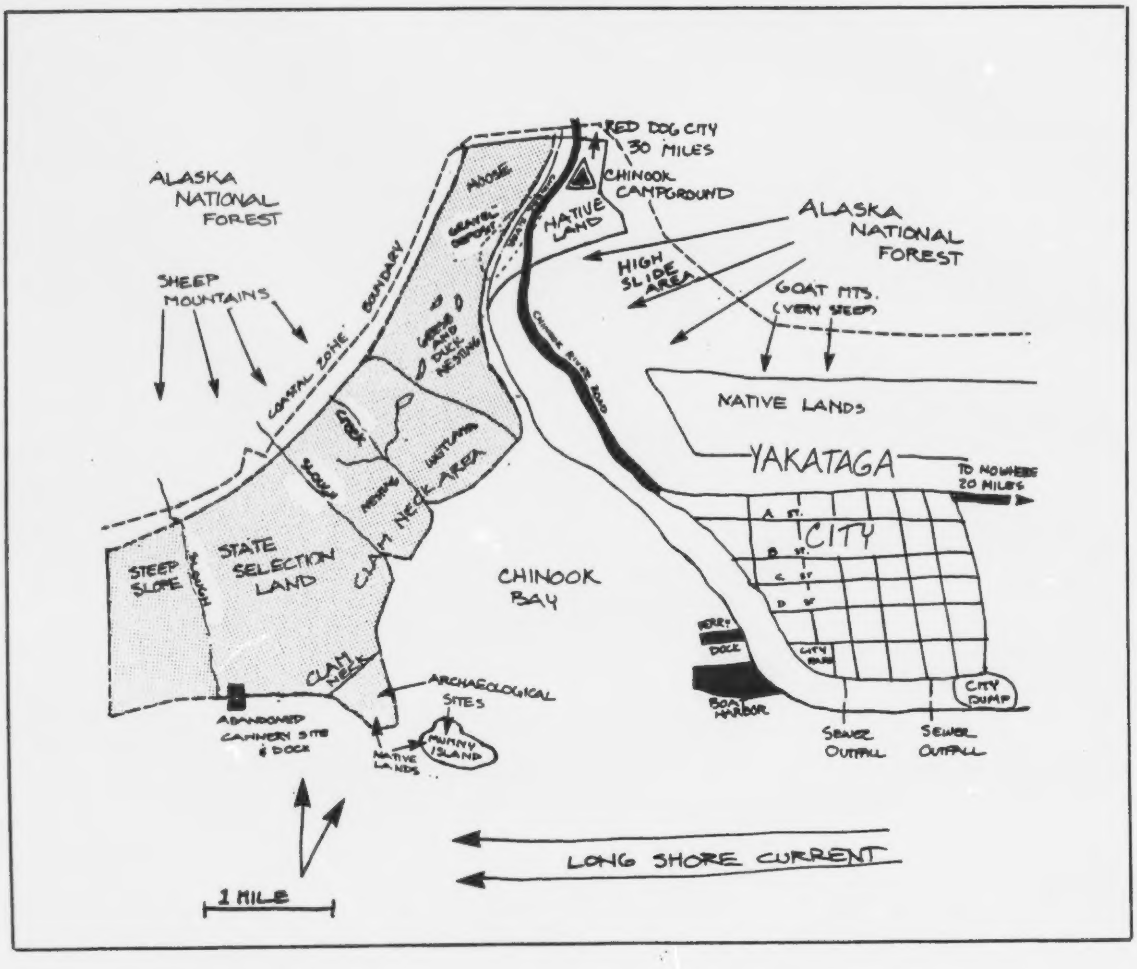
13. The Chinook River estuary is part of a migratory flyway for a number of species of ducks and geese. Every fall there is a moose-hunting season.

14. The Alaska Borough is an organized borough. Recently the area on the map marked "State Selection" (in gray) was conveyed to the State. The rest of the borough's Coastal Management plan is complete. The borough is now planning the management of the newly transmitted state selection area.

1C

ALASKA BOROUGH MAP

The federal government has conveyed to the state a six square mile tract of land in the coastal zone of the Alaska Borough. This land may remain in state ownership, may be selected by the borough, or portions may pass into private ownership by way of a land sale. Read the background information for the Alaska Borough. You will be helping to decide what to do with this state-selected land.


ALASKA NATIONAL FOREST
SHEEP MOUNTAINS
COASTAL ZONE BOUNDARY
MOOSE
GRAVEL DEPOSIT
GEESE AND DUCK NESTING
CREEK
SLOUGH
NESTING
WETLAND
CLAM NECK AREA
STATE SELECTION LAND
STEEP SLOPE
SLOUGH
CLAM NECK
ABANDONED CANNERY SITE & DOCK
ARCHAEOLOGICAL SITES
NATIVE LANDS
MUMMY ISLAND
RED DOG CITY 30 MILES
CHINOOK CAMPGROUND
NATIVE LAND
HIGH SLIDE AREA
ALASKA NATIONAL FOREST
GOAT MTS. (VERY STEEP)
CHINOOK RIVER ROAD
NATIVE LANDS
YAKATAGA
TO NOWHERE 20 MILES
CITY
A ST.
B ST.
C ST.
D ST.
CHINOOK BAY
FERRY DOCK
BOAT HARBOR
CITY PARK
CITY DUMP
SEWER OUTFALL
SEWER OUTFALL
LONG SHORE CURRENT
1 MILE

PLANNING COMMISSION RATING FORM

Directions: Give each plan 1-5 points (5 points is best, 1 is worse) depending on how the plan contributes to the Alaska Borough.

Plan	Marina	Airport	Park	Logging Mill	Homes
Contribution to Community Lifestyle					
Economics (Money)					
Wildlife and Fisheries					
Water-Dependent					
Community Beauty					
Jobs					
Other					
Total Points					

Things to consider:

- Are all of the criteria equally important? ______________________

  ____
- What additional criteria should be used? ______________________

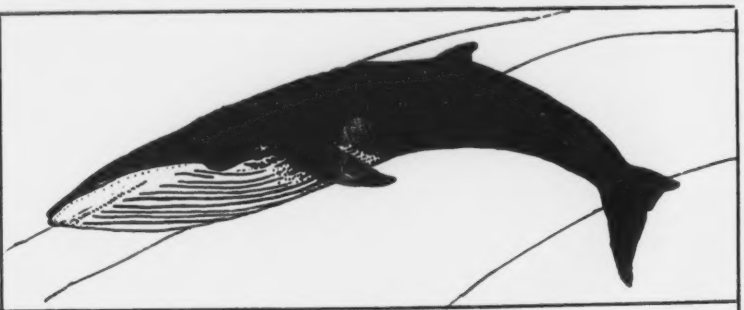
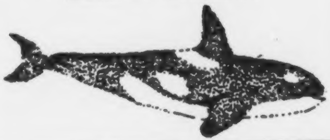
  ____
- Are there any criteria that should be deleted? ______________________

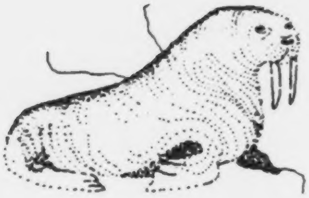
  ____

2A

Sea Mammal Characteristics

Directions: Cut out the squares and sort them with the underlined headings.

All Mammals		
Most are remarkably intelligent, especially the cetaceans	Have true hair at some stage	Adaptations such as flippers, fins and webbed feet equip them for life in the sea or on sea ice
Breathe air through lungs	Four-chambered heart	Sea Mammals 
Give birth to live young	Depend completely on food taken from the sea	Live mostly in salt water or on sea ice
Generally peaceful, unaggressive animals	Suckle young with milk produced by mother	Warm-blooded



Pinnipeds

2B

Directions: Use reference books to answer these questions:

1. Write a sentence that explains the characteristics common to all animals that are pinnipeds.

   ____

   ____

   ____

2. Draw a picture of (a) the front flippers of a pinniped, and (b) the rear flippers of a pinniped.

3. If your hands and feet were taped together to resemble a pinniped, what might you be able to do well? a. __________

   ____

   What would be difficult for you to do? b. __________

   ____

4. Under the following family names, list all the animals you can.

   PHOCIDAE OTARIIDAE ODOBENIDAE

2B

5. Sometimes pinnipeds are killed and parts of their bodies are removed, yet the meat is not used for food. Where are some places this happens?

____

____

6. What parts are removed? ______________________

7. What are the parts used for? ______________________

8. Should this be allowed to continue? ______________________

Why? ______________________

Why not? ______________________

9. List how pinnipeds are useful to humans and how they are destructive.

USEFUL THINGS	DESTRUCTIVE THINGS

10. Draw a picture of your favorite pinniped.

Cetaceans

2C

Directions: Use reference books to answer these questions.

1. What is the difference between a dolphin and a porpoise?

____

____

____

2. Under the following subgroups, list all the animals you can.

ODONTOCETI	MYSTICETI

3. What does Odontoceti mean? ______________________________

4. What does Mysticeti mean? ______________________________

5. Draw a picture of some different kinds of plankton.

6. What are krill? ______________________________

2C

7. Why do scientists think cetaceans are very intelligent?

____

____

____

____

8. Why are many whale species endangered? ______________

____

9. Draw a picture of your favorite cetacean.

Other Marine Mammals

2D

Directions: Use reference books to answer these questions.

1. The order Sirenia includes something called the Steller's Sea Cow. When was the last time this animal was seen? ____

2. Draw a picture of a Steller's Sea Cow.

3. If you saw a Steller's Sea Cow, how would you be able to distinguish it from any other marine mammal? ____

4. Where are manatees found? ________________________

5. Describe what a dugong looks like. ________________________

6. How do polar bears keep warm? ________________________

7. How does a sea otter feed? ________________________

2D

8. What are the differences between sea otters and river otters?

____

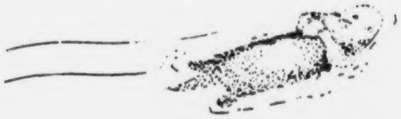
____

____

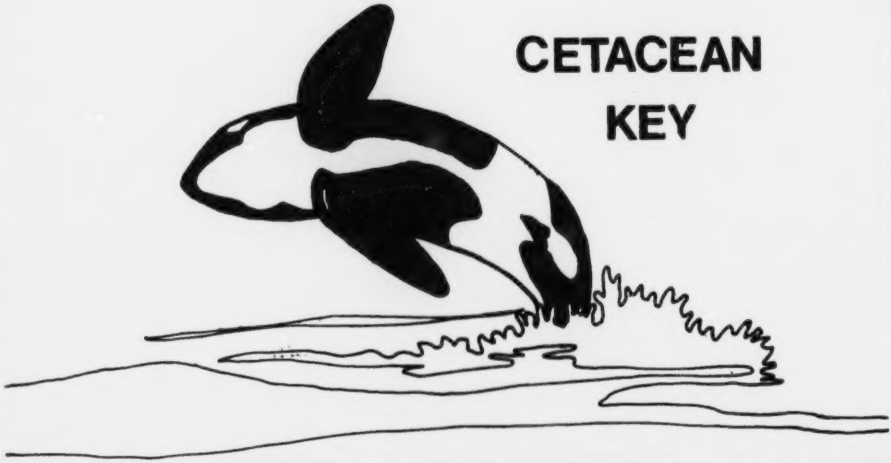
9. Why did sea otters almost become extinct? ______________

____

____



CETACEAN KEY



START ➤

1

toothed whale
➤ 2

baleen whale
➤ 7

2

Triangular shaped dorsal fin
➤ 3

no dorsal fin
➤ 4

3

it is a
KILLER WHALE
(ORCA)

4

large, square head, one third of body length; thin lower jaw
➤ 5

head is not large and square; lower jaw juts out
➤ 6

5

it is a
SPERM WHALE.

6

it is a
BELUGA WHALE.

7

long grooves on underside of whale
➤ 8

no obvious grooves on underside
➤ 9

8

it is a
BLUE WHALE.

9

whale has bumpy backbone ridge near tail
➤ 10

no bumpy backbone ridge near tail
➤ 11

10

it is a
GRAY WHALE.

11

white markings on chin
➤ 12

no white markings on chin; has calloused "bonnet" above mouth
➤ 13

12

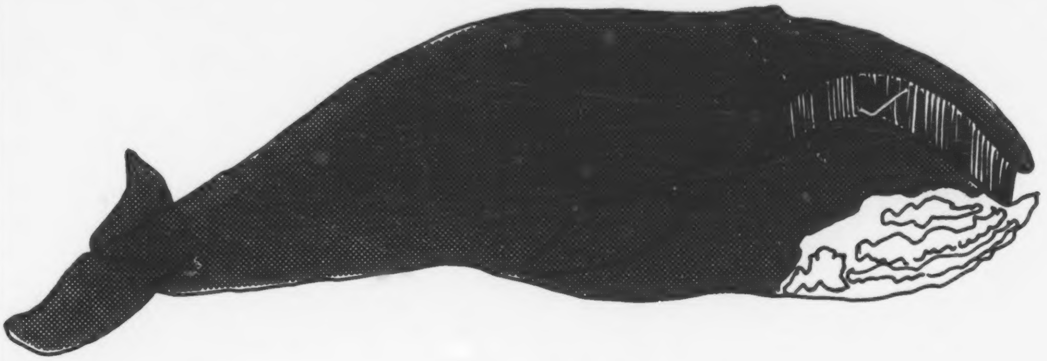
it is a
BOWHEAD

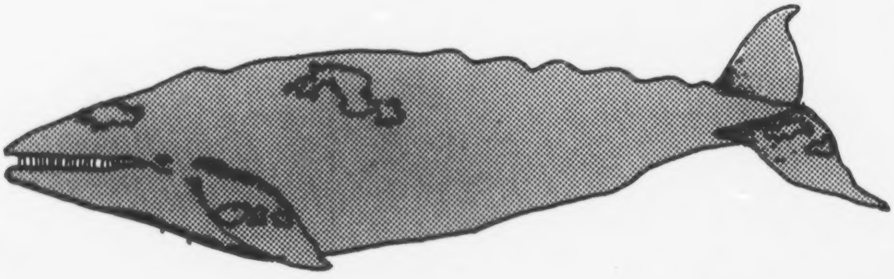
13

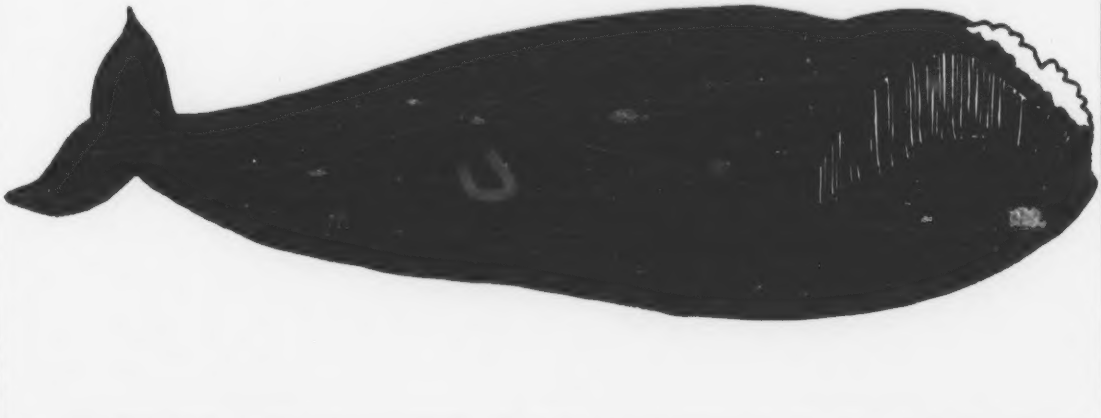
it is a
RIGHT WHALE

Developed by Laurie Dumdie, Washington Sea Grant, Pacific Science Center, Seattle, Washington.

2E







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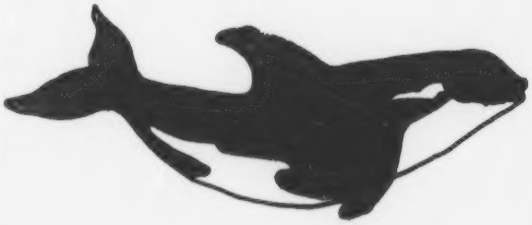
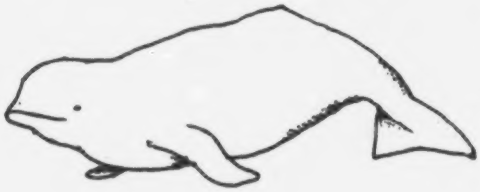
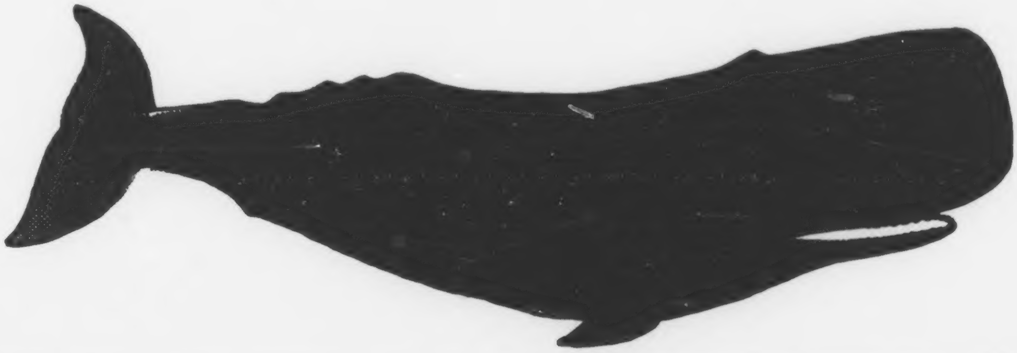




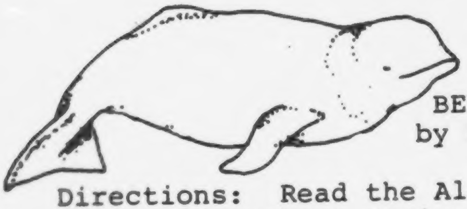


2E

RIGHT WHALE	BOWHEAD WHALE
KILLER WHALE (ORCA)	GRAY WHALE
BELUGA WHALE	BLUE WHALE
SPERM WHALE	

Beluga Bubble Puzzle

2F



BELUGA BUBBLE PUZZLE
by Don Gillespie, Koyuk

Directions: Read the Alaska Department of Fish and Game's Wildlife Notebook Series on beluga whales (sometimes spelled belukha) or do your own research. Then fill in blanks to fit the bubble puzzle below.

1. Adult belugas are white in __________.

2. The __________ Delphenapterus leucas ever recorded was 22 feet.

3. The __________ part of a beluga's head changes shape, possibly with the reception and production of sound.

4. As an __________, a beluga will have 40 teeth.

5. Belugas range from the __________ to the subarctic regions of North America and Europe.

6. The __________ is believed to be the wintering area of the beluga.

7. A beluga was once sighted near __________ many miles up the Yukon River.

8. Belugas eat __________, other fish, squid and shellfish.

9. Through __________ of their habitat, we will help the beluga survive.

1. ○ _ _ _ _
2. _ _ _ _ ○ _ _
3. _ _ _ _ ○
4. ○ _ _ _ _
5. _ _ ○ _ _ _
6. _ ○ _ _ _ _   _ _ _
7. _ _ _ ○ _ _
8. _ _ _ _ _ ○
9. _ _ _ ○ _ _ _ _ _ _ _ _

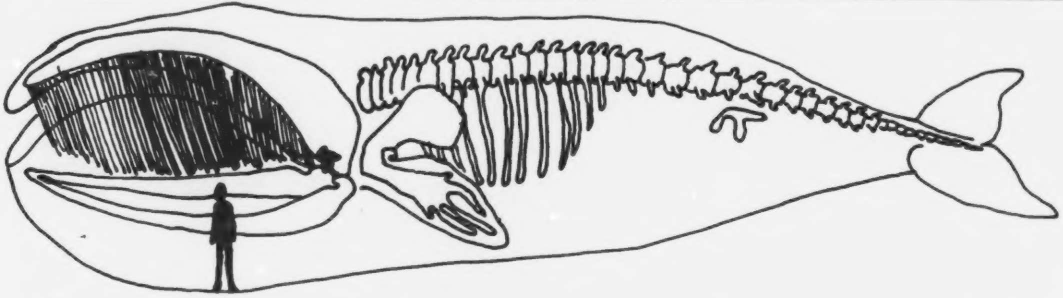
2G

Whale in the Water

Adapted from the ORCA Whales curriculum developed by the Pacific Science Center and Washington Sea Grant.

Directions: Read and answer the questions.

1. Whales are the largest creatures ever to have lived on earth. A blue whale may grow to be 100 feet long. Whales are so big that they can only live in the ocean. Like Brontosaurus and other large dinosaurs, they need water to help support themselves. On land, they would be crushed to death under their own weight. Look at the skeleton of a right whale below. Note the three bones coming off the backbone toward the rear of the whale. What purpose do you think they serve?



2. Compare the number and arrangement of bones in a whale's flipper with a human arm and hand.

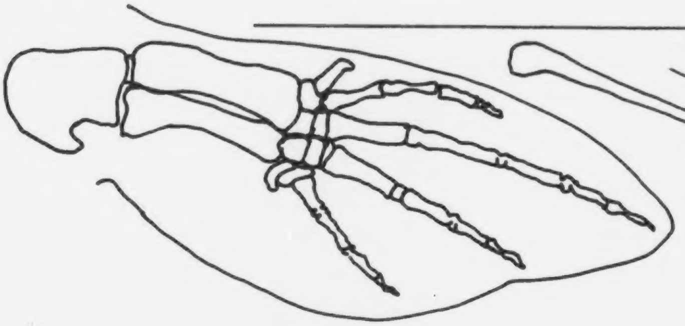
   a. How many "arm" bones does a whale have?

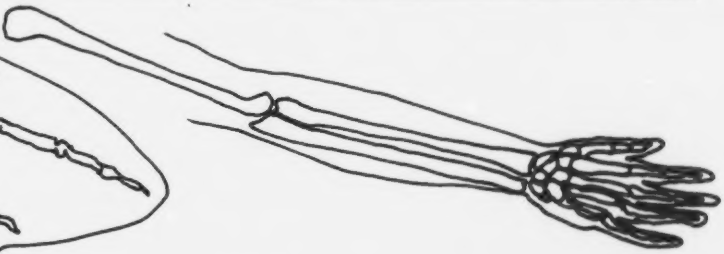
      human have?

   b. How many "digits" are in the human hand?

      in the whale flipper?

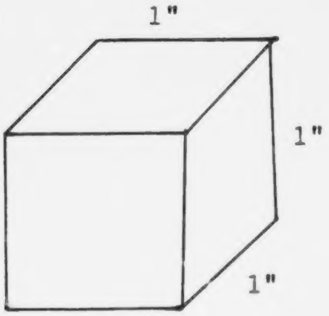
   c. What does this tell you about whales and humans?

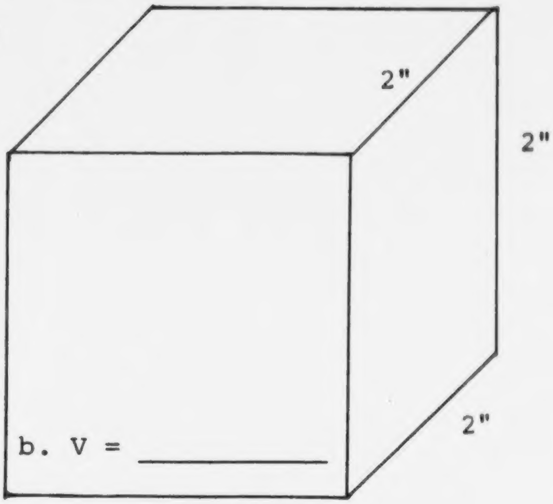




3. Whales have adapted to the water in many ways. One thing that helps them survive in the cold arctic water is their huge size. Figure the volume of these two cubes.

V = lwh





a. V = __________

b. V = __________

c. How many of the 1-inch cubes would fit in the 2-inch cubes? ____________________

Imagine the 1-inch cubes inside the 2-inch cube. Adding up the inner surface areas of the 1-inch cubes gives the amount by which their surface area is greater than the 2-inch cube's. Similarly, a baby whale has a larger surface area in proportion to its volume than its mother, and loses heat much faster.

d. Give another example of this principle.

____

____

4. What other adaptations would be helpful to a whale? Circle yes or no to the following possibilities and give your reasons.

a. glands that oil the eye. Yes/no because __________

____

b. fur. Yes/no because __________

____

c. young born head first. Yes/no because __________

____

d. sweating. Yes/no because __________

____

e. streamlined shape. Yes/no because ______________________

____

f. layer of blubber. Yes/no because ______________________

____

g. arms and legs. Yes/no because __________________________

____

h. concentrated urine. Yes/no because ____________________

____

i. curling up to keep warm. Yes/no because ______________

____

j. low heart rate while diving. Yes/no because __________

____

k. echolocation system. Yes/no because ___________________

____

l. tear ducts. Yes/no because _____________________________

____

m. tail and flippers. Yes/no because ______________________

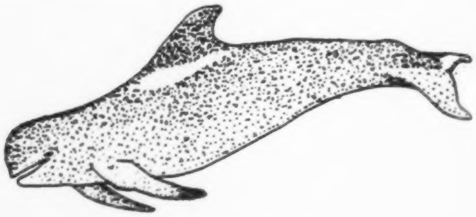
____

n. hold breath while diving. Yes/no because _____________

____

o. breathe through the top of the head. Yes/no because

____



Gray Whale Migration

2H

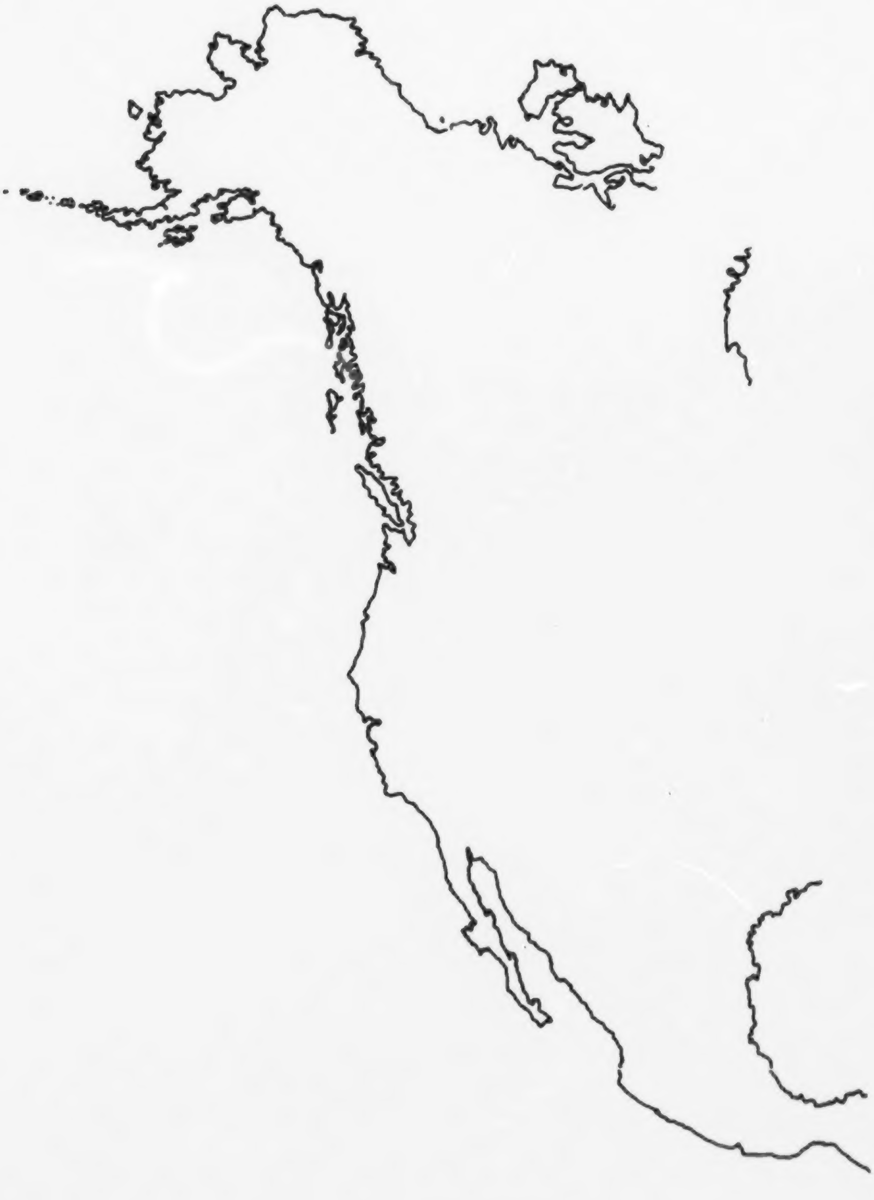
Gray whales make the longest migration of any mammal--10,000 miles round trip. Gray whales breed and calve in the warm water lagoons of Baja California from late December to early March. Then they head north past California, Oregon and Washington, and on to Vancouver Island in British Columbia. There, they gather in groups for the trip across the Gulf of Alaska. No one is sure what route they take to their summer feeding areas in the Bering, Chukchi and Beaufort seas where they spend May through September, feeding on 1-inch-long amphipods and other bottom-dwelling invertebrates. These amphipods in turn feed on the rich growth of plankton (tiny plants and animals) that result from the long hours of sunlight. In October, as the ice pack starts to form, the whales head south through Unimak Pass in the Aleutians. They travel very close to shore on their southward migration. Today's date is _______________. The gray whales are probably _________

____

____.

2H

Mark the gray whale's migration route on this map. Label the landmarks along the way, plus their breeding and calving area and feeding area. Also, list the time of year spent in each area.



Say "Rooo-bee!"

by Malcolm Brenner

Editor's note: Malcolm is a person who wanted to find out something about dolphins, so he began working with a captive female dolphin, named "Ruby," in Florida.

It occurred to me that I could use this game of catch as a reward in an attempt to get Ruby to vocalize. It seemed like an ideal reward; we were both enjoying the game, and her participation was voluntary. I decided to try to get her to mimic her own name.

"Ruby," I said. "Say, Rooo-beee!"

All I got back at first was a bunch of dolphinese, somewhere between a whistle and a squawk. I threw the ball, and she returned it.

"All right, now, say 'Ruby!' Rooo-beee!"

...I noticed that she was repeating the same sound every time; it wasn't just any old squawk, but one with recognizable characteristics...

Suddenly her vocalization changed. Her squawk came out in two distinct syllables, rather like the way I had been syllabificating "Rooo-beee!" I hurled the ball, and she returned it. Our progress became unbelievably rapid. In the space of five minutes, she began to copy the syllabification, rhythm, time, and inflections of my pronounciation of the word "Ruby," and she did so with an accuracy and a speed I found amazing... We became completely wrapped up in each other, the outside world ceased to exist... Never in my life have I known such an intimate feeling of being in contact with an incredible non-human creature. It felt as if it were what I had been created to do. Our minds seemed to be running on the same wave-length. We were together.

She repeated the word with accuracy a couple of times, then started babbling at me in dolphinese, shaking her head up and down with her jaws open in that gesture, usually associated with pleasure, that I called "ya-ya-ing." I tried to get her to say "Rooo-beee!" again; more ya-ya-ing. Then she swam back a few feet and made a peculiar noise, a kind of "kee-orr-oop," but about three times faster than you pronounce it. It occurred to me--I don't know why--to repeat that sound. Ruby seemed to be expecting it of me. I did the best I could with it. She repeated it, but now it sounded slightly different; I mimicked her changes. Gosh, she's doing to me what I was just doing to her! Where will this lead? By now the ball was forgotten; I was totally absorbed in listening to Ruby's vocalizations and attempting to mimic them as accurately as possible with my inadequate lips and vocal cords. She repeated the sound again, changed still more, and I copied that, she repeated it again, and as I tried to mimic her I thought, this sounds vaguely familiar--"kee-orr-opp." The light in my head went on. *The sound I had just successfully imitated was the one she had been giving to me in the beginning*, in response to my first attempt to make her say "Ruby!"

This realization struck me as the sound was coming out of my lips. Several fuses in my mind blew simultaneously and I did an incredible double-take, nearly falling over, and staring at Ruby, who was watching me with great concentration. When she saw the double-take, and knew I knew, *she* flipped out, and went ya-ya-ing around the pool, throwing water into the air, and apparently happy that this two-legged cousin of hers was progressing so rapidly.

What do I think the meaning of that experience was? I don't really know. I have some *ideas*, however. In response to an English word, Ruby had given me a dolphinese word or phrase, which I had ignored. She succeeded in taking control of the situation--*although I had been willing to relinquish control*--and had then tricked me into producing the sound I had at first ignored! *I had been the one slowing down the communication between us*! But what was the meaning of that sound? I can only guess. Certainly Ruby was sophisticated enough to recognize her human name. It occurred to me that she was most likely either telling me her name for *me* or telling me her name for herself.

Years later, I told a couple of "straight" dolphin researchers about the experience. (By "straight" I mean they regard the possibility of a high dolphin intelligence as undemonstrated, and therefore not worth investigating.)

"It's too bad you didn't have a tape recorder with you," they told me. "So often one hears what one *wants* to hear." Some outside impartial reference source is necessary to evaluate experiences like this in a truly scientific context. One's own subjective sensory impressions are, alas, so often subject to distortion.

"Say 'Rooo-beeee'" by Malcolm Brenner is from *Mind in the Waters*, ed. Joan McIntyre. Copyright © 1974 by Charles Scribner & Sons. Reprinted by permission.

Answer these questions:

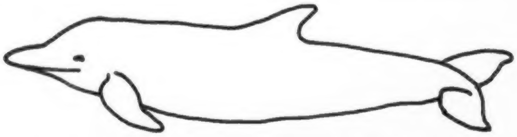
1. What's your opinion of what was happening in the story--was Ruby really trying to teach Malcolm something, or did Brenner hear what he wanted to hear?

____

____

____

____



2. What experiments would you like to try with Ruby?

____

____

____

____

____

3. How would you try to learn to talk with Ruby?

____

____

____

____

2J There's a Whale On My Beach

Sometimes marine mammals get stranded and need human care and concern for a short time. If a whale was ever stranded on your beach, would you know how to give first aid? ___________

Here's what the International Fund for Animal Welfare recommends:

> Be careful. The sheer massive size and power of a stranded whale may be dangerous.
>
> Check to see if the animal is alive. In some whale species, there could be a 10-15 minute span between movements.
>
> Try to correctly identify the animal. Measure its length and note its color and distinctive features.
>
> Send someone to call the Alaska Department of Fish and Game, the State Troopers, or the University of Alaska. Give them information on the stranding and its exact location. Also call the Scientific Event Alert Network at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Dial (800) 325-6000 and charge to ID #1776. And call the regional National Marine Fisheries Service at (206) 442-7676.
>
> Do not try to push the animal back to sea. Remember, it is a mammal and needs to breathe air. If it is too sick or injured to support itself, it can drown. With first aid, it is better off left where it is found. If the animal appears healthy, however, and scientists cannot come to investigate and assist with first aid, then try to document the animal's identity with photos and descriptions. Then carefully attempt to return it to the water.
>
> For single strandings of whales, porpoises, and dolphins...

1. If an animal is caught in pilings, rocks or other obstructions, remove it into a stable position. And keep the animal belly down whenever possible, as animals on their sides in water are likely to drown.

   On beaches, scoop out the sand that's propping up the front flippers. Dig a hole (without a drain) so the animal is not resting on its flippers. The primary objective of first aid for a stranded whale or dolphin, at least in warm weather, is to get rid of heat. If the animal rests on its flippers, this position will cut off circulation.

2. If possible, erect a make-shift shelter to provide shade. This may be a simple lean-to, constructed from tarpaulins.

3. Apply water-soaked, light-colored towels, sheets or cloths to as much of the body as possible. Resoak the towels frequently to keep the animal's skin moist. If the whale is extremely large, be sure to at least keep the appendages cool--since the flippers and tail flukes are instrumental in body heat regulation. The biggest problem for a stranded whale or dolphin is getting rid of body heat. Under ideal conditions, plastic bags filled with crushed ice should be placed around the flippers and flukes only.

4. Do not obstruct the blowhole coverings. Keep water out of it. The blowhole is the means by which a whale or dolphin takes in and breathes out air.

5. Apply lanolin, vaseline or zinc oxide to areas you have to leave exposed to the sun. Do not use suntan lotions or other preparations.

6. Cooperate in careful crowd and noise control. Try to ensure a minimum of handling and disturbance for the animal, since it is already--by the nature of its stranding--undergoing considerable stress. At night, no lights or flashbulbs should be shone directly in its eyes.

In case of a mass stranding...

1. Deal with the animals in the water first. Keep them from coming out onto the beach. Hold the animals bunched together in sheltered, shallow water in an upright position. Remember, if manipulated improperly the animals will thrash around, causing further injuries to themselves and probably to the personnel working with them. Use the utmost care in moving the animals in the water: Push only on the sides of the animal or at the base of its dorsal (back) fin; never push or pull hard on the flippers; completely avoid the head and tail. If an animal is lifted or pulled in an improper manner, it may be severely injured. Always wait for experienced persons to apply any mechanical means to move the animals. Severe injury may be inflicted from ropes, hooks, crowbars, etc.

   Using minimal physical activity and force, try to keep any additional animals from getting out of the water and piling up one on top of one another on the beach.

   Do not, however, try to push them back into the open sea. This action could result in scattering--then you will be dealing with many single strandings over many miles of beach.

Keep in mind that more harm could be done to the animals by well-intentioned pushing and pulling than if the animals are allowed to come out of the water and pile up on the beach.

2. If the shore formation allows, dig trenches from the water in toward the beach. The trenches should be deep enough to allow seepage of sea water at low tide. By digging irrigation ditches, you will make the sea accessible to animals already on the beach, and significantly cut down on suffering from retention of heat.

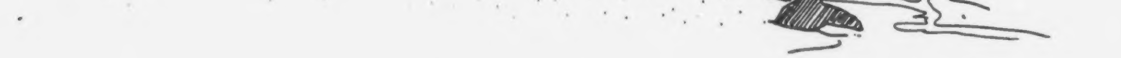
   The trenches should lead to scooped-out areas in the sand, forming big, shallow pools for stranded animals closest to the water. Fortunately, most mass strandings in North America have occurred on long, shallow beaches, facilitating the channeling of water to the stranded animals.

3. Apply individual first aid to those animals already far up the beach.

NOTE: The following approximations of length-weight ratios may be an aid in handling considerations:

6 ft. = 200 lbs.
8 ft. = 400-500 lbs.
12 ft. = 1,500 lbs.
15 ft. = 3,000-4,000 lbs.
large whales = 1,500-2,000 lbs./foot

1. Now apply what you know to this stranded _______________ whale. Explain what you would do. Draw arrows to the points of its body requiring special assistance.



2. Figure the person (you) in the picture is 5 feet tall. How long is the whale? ___________________

3. How much does it weigh? _________________

Humpback Whale Case

2K

The humpback whale (Megaptera novaeangliae) used to be an important part of the whaling industry. In the early part of this century, many humpbacks were taken by the shore stations in the North Atlantic. By 1916, there were only a few dozen animals left. Harvesting stopped until the 1940s when their numbers had recovered enough to make hunting profitable again. The population was drastically reduced again, and finally in 1966, the humpback whale was given complete protection by the International Whaling Commission. No one knows for sure how many humpbacks there were originally, but scientists think the number in the North Pacific Ocean has remained at about 1,200 since 1966. There are probably about 2,000 in the North Atlantic, and populations may be increasing slightly. Humpbacks in the southern oceans number about 3,000; there may have been as many as 100,000 at one time.

Although the humpback is no longer hunted, there are new threats to its existence. The number of humpback whale sightings has gone up the past few years in the Newfoundland area; during this same time, report of whale-caused damage to fishing gear has also gone up. The whales get accidentally entangled in the trap-lines. It is not that they are attempting to get the fish or bait in the trap--they just don't seem to be able to sense the lines. Damage to the traps is costly, and fishermen lose many fish while they are repairing whale-damaged traps. The result is that fishermen end up paying the cost of a conservation policy (i.e., the hunting ban on the humpbacks). Some have concluded that since more humpbacks are seen close to shore, the population has risen and whaling should be allowed. It may be, however, that humpbacks are feeding closer to shore than before because of overfishing of their favorite food-fish--capelins--by humans. It could also be that more whales are caught because cod fishing has become more popular, and there is more fishing gear (traps and nets) in the water than ever before.

Another threat to the humpback may be coming from whale lovers. Charter boats are running whale-watching trips, and many pleasure boaters are cruising the whales' breeding grounds to get as close as possible to the animals. Not only are cows and calves being frightened away from their traditional places, but courting whales are often interrupted by boaters. This could affect humpback birth rates. In California, there have already been collisions between gray whales and hydrofoils. That is bound to happen off Maui, too. A scientist has reported that he observed a humpback that stopped singing when a hydrofoil came near. We still do not even know why humpbacks sing; how can we know what might be the effect of hydrofoil or other boat noise on their lives?

2K

Now answer these questions:

1. What is one of the problems facing humpback whales, and what is a possible solution?

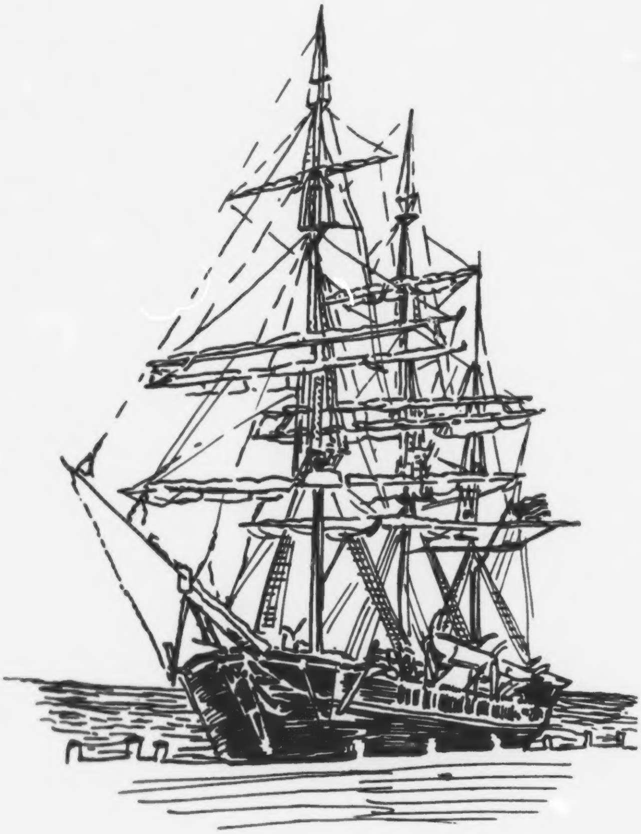
2. You are a biologist proposing a long-term study of humpback whales that migrate between Alaska's Glacier Bay and Hawaii. The study will attempt to identify and keep track of individuals and pods from year to year. In order to get money for the study, you must convince the National Science Foundation that there is much useful information to be gained. What do you tell them?

3. Imagine you are a scientist with the International Whaling Commission (IWC) in 1966. At this time, the IWC is debating the quota of humpback whales to be captured, or whether to completely ban hunting them altogether. You are to provide the information needed to make the decision. What information do you need, and how do you get it?

After the Whale

The following is a condensed version of an article by John Bockstoce, Curator of Ethnology, Old Dartmouth Historical Society Whaling Museum, New Bedford, Massachusetts. The original version, "History of Commercial Whaling in Arctic Alaska," appeared in ALASKA GEOGRAPHIC, Volume 5, Number 4, Alaska Whales and Whaling, Copyright © 1978 by Alaska Northwest Publishing Company. Permission for the condensation granted by the author.

Directions: What would it have been like to be on an old-time commercial whaler along Alaska's coast? What would you have needed to take with you? As you read through this brief history, begin making a list of needs (see question 7 at the end).



Whalers from New England first reached Alaska in 1835. They reported abundant sperm and right whales around Kodiak. Soon ships were chasing whales up through the Aleutians and into the Bering Sea.

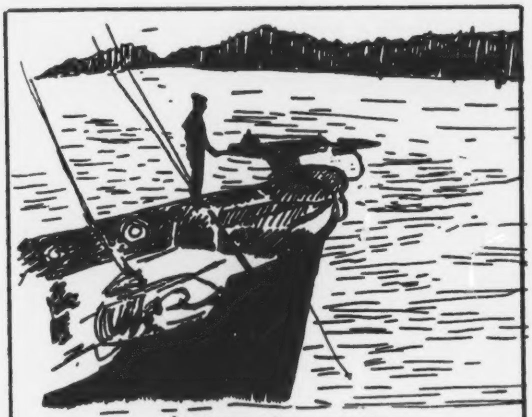
In 1848, Captain Thomas Roys pushed his way through northern mists into seas unknown to whalers. With a terrified, nearly mutinous crew, Captain Roys forced his way through the Bering Strait and into an Arctic Ocean shrouded in fog. But one day in July, the fog lifted, and these once-frightened hunters began to take whales so quickly that in a month they had filled their ship. They soon set sail for Hawaii with 1,800 barrels of oil in the hold. News of this discovery touched off an unprecedented oil rush to the Bering Strait. In 1849, more than 70 ships sailed there, and the number continued to grow annually. By 1852, more than 200 vessels were operating in those waters, but the 1852 season turned sour. On top of that, the subsequent 1853 and 1854 seasons were just as disastrous.

Consequently, ships headed over to the Okhotsk Sea, off the Siberian coast, to hunt whales. But catches quickly declined there, too, and in 1858, ships began returning to the Bering Strait.

Normally the whalers would arrive in mid-June. While waiting for the ice to melt, they would trade with Alaska Natives for fur and ivory. Whalers also killed walruses for their oil and tusks. And by July, they could begin to hunt the bowhead, although they always had to be very careful to get back through the Bering Strait before the ice froze them in. As many Alaskans well know, winter comes early and fast in regions lying at such extreme northern latitudes.

1865 marked the beginning of a series of tragedies for the whaling industry. The last encounter of the Civil War took place near the Bering Strait, when the Confederate raider Shenandoah burned 20 whale ships and caused the wreck of another. In 1871, 32 ships were abandoned between Point Belcher and Icy Cape when ice trapped them. And in 1876, 12 more ships were lost near Point Barrow. Almost every year, one or two vessels were wrecked or crushed in the ice.

Additionally, whale prices began to decline significantly, as people began to substitute petroleum for whale oil. In an attempt to offset this trend, the whalers tried to increase their catches. As they had difficulty finding whales, they turned to walrus. Between 1868 and 1880, as many as 100,000 walruses may have been taken. Oil prices continued to fall, but what temporarily saved the industry was the baleen, or whalebone, market. In the 1870s, the fashion industry began to require baleen for corset stays and skirt hoops. Baleen was the only material available that approximated the qualities of modern plastics.


harpoon gun ca 190

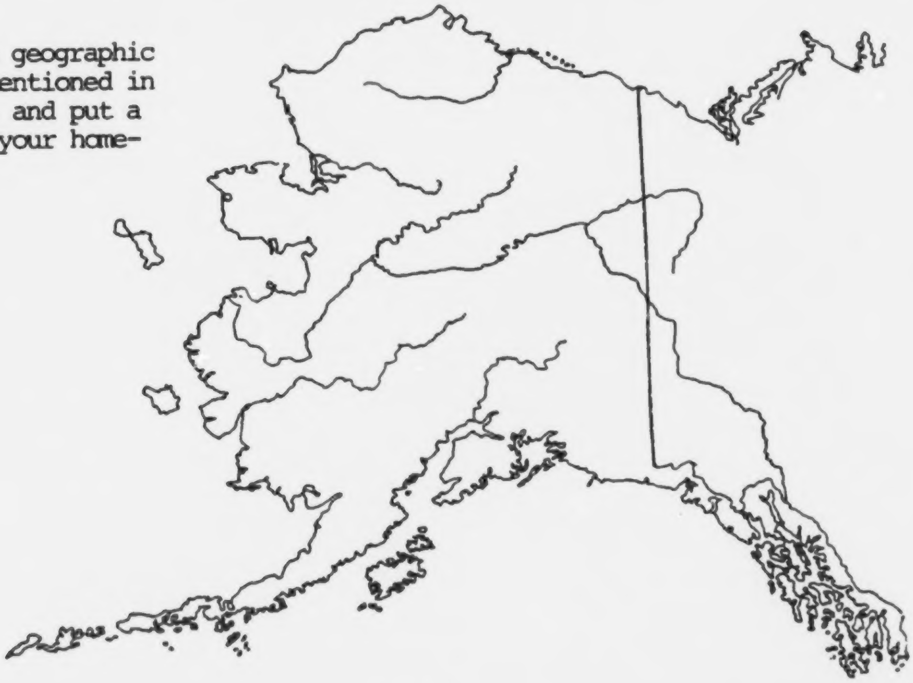
Because bowheads were becoming increasingly scarce, whaling companies began using steam auxiliary ships that could go among ice floes where no sailing ship dared to go. And the whaling companies decided to start shore-based stations to take advantage of the skills and techniques developed by Inupiat Eskimo whalers. The first station was established in 1884. Within a few years, 15 stations were established between Point Barrow and Cape Thompson. A few men ran each station, with the help of largely Inupiat Eskimo crews. Eight men were needed for each crew, and sometimes a station had 20 crews. The competition for crew year's supply of flour, as well as rifles, cartridges and other food and manufactured goods, in payment for the two-month whaling season. As a result, Eskimos began to concentrate around the stations, developing a dependence on manufactured goods.

Bowhead whales continued getting more scarce. Then in 1887, Charles Brower, the manager of the Cape Smythe Whaling and Trading Company at Point Barrow, heard from Eskimo traders that they had seen large numbers of whales in the shallow waters of Mackenzie Bay. So Brower outfitted one of his men, Joe Tuckfield, with a whale boat and an Eskimo crew, and sent them east on a reconnaissance voyage. When Tuckfield finally returned in 1889, he reported that whales were "thick as bees." This started the last great whaling rush, and pushed the whales--already severely reduced--toward extinction. The reconnaissance crew had found the bowhead's summer feeding grounds--their last refuge.

Over the next 20 years, more than 100 voyages were made to these waters. But 1897 was the beginning of the end. That year, four ships were lost to the ice pack, and four others were forced to seek emergency quarters on the coast. Ironically, it was the very scarcity of the whales that saved them. As fewer and fewer were caught, the price of baleen rose higher, reaching more than $7 per pound. Consequently, the high price invited cheaper substitutes. Spring steel was soon introduced for corset stays. In 1907, the price of baleen dropped 75 percent, and the whaling market ended for all practical purposes.

1. Make a timeline of commercial whaling events along Alaska's coast.

2. Label the geographic place names mentioned in this history, and put a star next to your hometown.



3. An average bowhead gave 100 barrels of oil. How many bowheads did Captain Thomas Roys' crew kill in 1848?

____

4. Each barrel held 31½ gallons of oil. How many gallons of oil did whalers get from an average bowhead?

____

5. How many gallons of oil did Capt. Roys' crew get in 1848?

____

6. An average walrus gave 20 gallons of oil. Estimates of up to 100,000 walrus were killed between 1868 and 1880. In this ______ year period, how much oil did these walrus give?

____

7. Imagine that you were leaving from New England for a 1½- to 3- year voyage to Arctic Alaska in 1850.

   a. What would you need to bring?

   ____

   ____

   ____

   ____

   b. What ship supplies would you hope they had along?

   ____

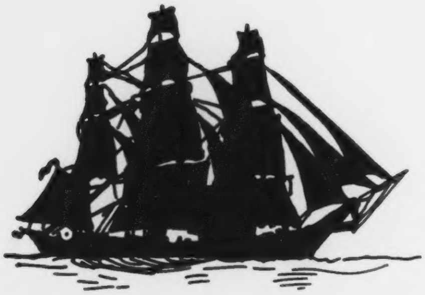
   ____

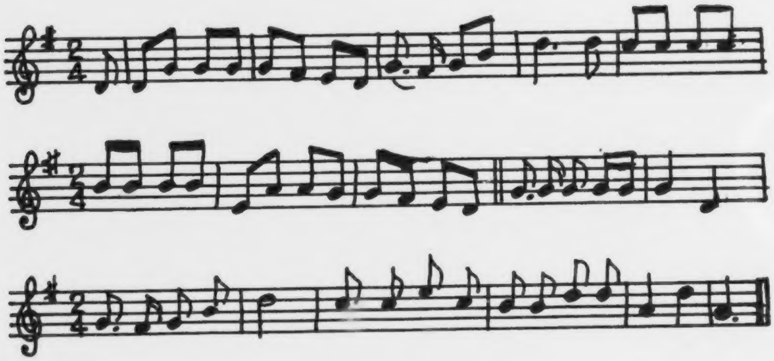
   ____

   ____

Blow Ye Winds in the Morning

2M





1. 'Tis advertised in Boston
New York and Buffalo,
Five hundred brave Americans
A whalin' for to go, singing:

Chorus:

Blow ye winds in the morning
And blow ye winds heigh ho
Clear away your running gear
And blow ye winds heigh ho!

2. They take you down to Bedford
That famous whaling port
And give you to some landsharks
To board and fit you out, singing:

3. They tell you of the clipper ships
A-going in and out
They say you'll have five hundred whales
Before you're six months out, singing:

4. It's now we're out to sea my boys
The wind comes on to blow
One half the watch is sick on deck
The other half below, singing:

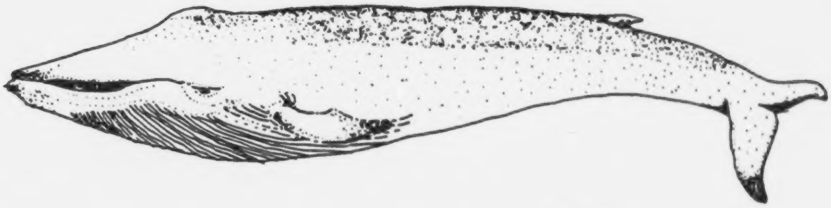
5. The skipper's on the quarter-deck,
A-squintin' at the sails,
When, up aloft, the lookout sights
A mighty school of whales, singing:

6. Then clear away the boats my boys
And after him we'll travel
And if you get too near his flukes
He'll kick you to the devil, singing:

7. And now that he is ours, my boys,
We'll tow him alongside
Then over with our blubber hooks
And rob him of his hide, singing:

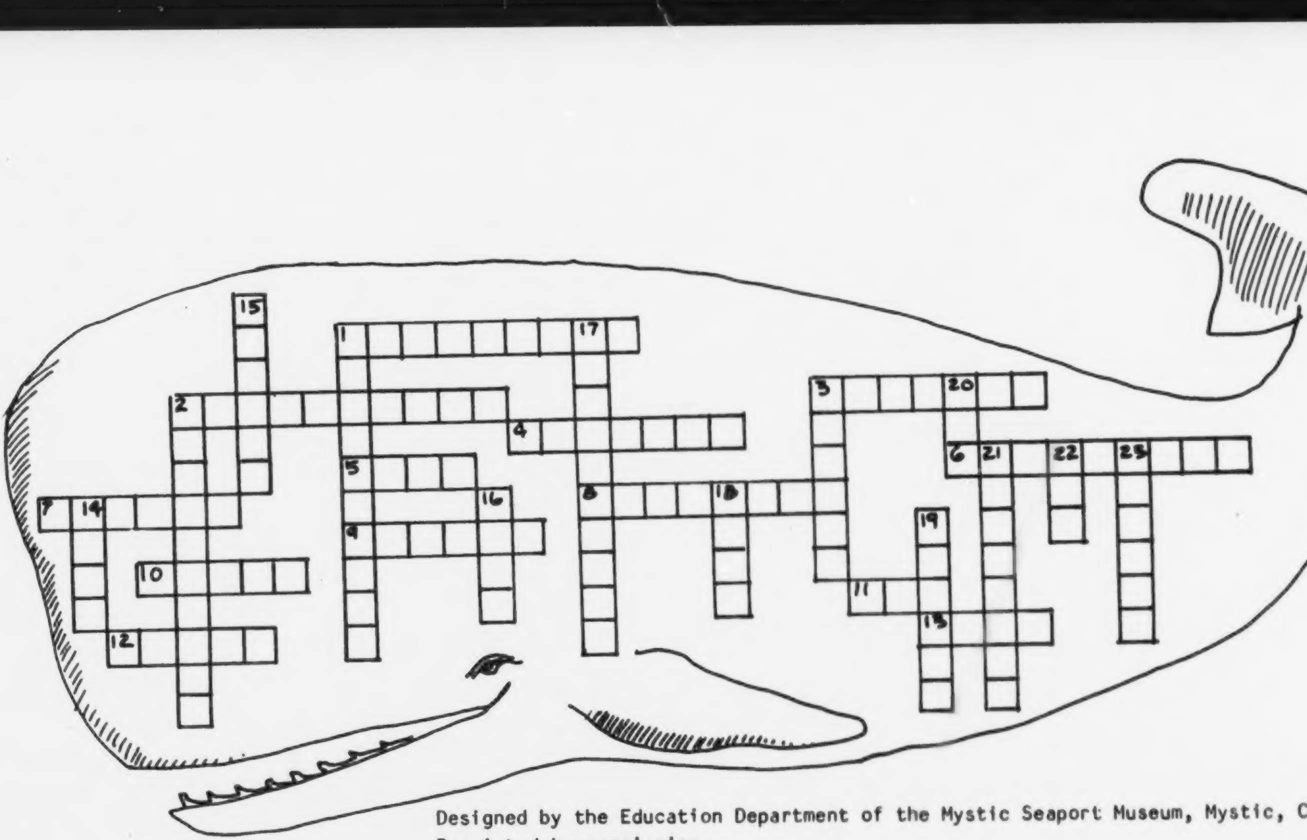
8. Next comes the stowing down my boys
We work both night and day
And we all have fifty cents apiece
On the hundred and ninetieth day, singing:

9. Our ship is full, we're homeward bound,
And soon we're through with sailing,
A friendly glass around we'll pass,
and blast this blubber whaling , singing:



2N

Old Time Whaling Puzzle



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ACROSS

1. The art of carving whale teeth.
2. A carved figure on a ship's bow.
3. Whale fat.
4. A tool used to catch a whale.
5. A ship's officer.
6. A small boat used for chasing whales.
7. The broad tail of a whale.
8. To direct a ship's course.
9. A man who makes barrels.
10. A long metal spear used for killing whales.
11. Near or toward the stern of a vessel.
12. A portion of the ship's company on duty at a given time to run the ship.
13. A plant fiber used in making rope.

DOWN

1. A waxy product found in the sperm whale's head and used to make candles.
2. The crew's living quarters in the forward part of the ship.
3. Whalebone. Strips found in the upper jaw of the right whale.
14. Rope.
15. One who installs rigging.
16. A floor on a ship.
17. A person learning a trade.
18. A sailor's personal belongings.
19. A nautical measure equal to six feet.
20. The front part of a ship.
21. One who steers a vessel.
22. A written record of a ship's cruise.
23. A wooden container.

20

Battle Over the Bowhead

An Alaska Tidelines TV Special

"BATTLE OVER THE BOWHEAD" is excerpted and adapted from Alaska Tidelines, Volume I, Number 6, March 1979. Virginia Sims, editor. Published by the University of Alaska Sea Grant College Program, Copyright © 1979. Reprinted by permission.

This is an imaginary TV news special. The people in it are imaginary, too. But the battle over the bowhead is very real. The event described here actually happened. And these arguments have been heard in one form or another at such widely varied places as international meetings in London or Tokyo or over a steaming cup of tea in a tent pitched on the ice at a whaling camp.

Read the script through. Then select members of your class for each part, and let each one choose a team of "advisors." Each part represents a different point of view, but there are many other arguments besides those presented here. Perhaps you and your advisors can add some of your own as you go along.

Cast of Characters

MODERATOR
JOHN, Eskimo whaling captain
KEN, U.S. delegate to the International Whaling Commission (IWC)
ALICE, member of the "Save the Whales" organization, Alaska chapter
EMILY, Alaska state legislator
STEVE, member of the IWC Scientific Committee
MIKE, biologist with the National Marine Fisheries Service (NMFS)
MARGARET, spokesperson for the oil and gas industry

MODERATOR: Good evening, ladies and gentlemen. The so-called "Battle Over the Bowhead" is not about whether or not the whales should be saved. We all agree that they must survive. And the Eskimos, whose traditions are built around the bowhead, know better than anyone else how empty our northern waters would be without them.

Nor is the battle a simple two-sided question of Eskimo subsistence against bowhead protection. It is far more complicated than that. There are many issues involved, including conservation, international politics, the impact of oil and gas development in the Arctic, the energy needs of the world, environmental protection, civil rights of minority people, and last but not least, survival of the great whales, among the most beautiful, fascinating, mysterious creatures ever to live on earth.

Some of these interests are represented on our panel here tonight. Let's start with you, John. We know it took some pretty heavy bargaining to get the International Whaling Commission to lift its ban against Eskimo subsistence hunting and allow you a quota of 12 whales. You agreed to that quota--but under protest. That was last year. What's going to happen this spring?

JOHN: We will be hunting, but under our own rules this time. We do not think the International Whaling Commission has any right to limit the number of whales we can take for food. We went along with the quota last year because we were told that if we cooperated, the quota might be lifted. Well, we did cooperate. But the quotas for this year's hunt are almost as bad as last year's. So this spring we will do it our way.

MODERATOR: Does that mean uncontrolled hunting?

JOHN: No, no! The bowhead whaling will be managed this year by our own Alaska Eskimo Whaling Commission. We will set and enforce limits that will not endanger the whales, but will meet the needs of our people. Let the IWC regulate the commercial whalers. We will regulate ourselves.

MODERATOR: Ken, perhaps you should tell us just what the IWC is and what it does.

KEN: The International Whaling Commission was formed in 1946 to conserve the whales by bringing commercial whaling under control. Since then, the worldwide whale kill has been cut almost in half, and no more whales have been added to the endangered species list.

The IWC sets quotas on whale populations considered large enough to harvest, and protects those species that are threatened. Most of its 16-member countries[2] were whaling nations when they joined, but now only a few continue to hunt commercially.

ALICE: Yes, but two of those IWC Nations--Japan and the Soviet Union--are the largest commercial whalers left. They account for about 85 percent of the whales killed each year. As you know, our "Save the Whales" group is totally against commercial whaling. And it seems to us that the IWC is dealing more in politics than in protection.

[2] Australia, Argentina, Brazil, Canada, Denmark, France, Iceland, Japan, Mexico, the Netherlands, New Zealand, Norway, South Africa, United Kingdom, U.S.S.R. and U.S.

KEN: It's a very touchy problem. You see, none of these nations *had* to join the IWC. We can't force any nation to sign the treaty. But once they are in, they listen to the advice of our IWC Scientific Committee and they are expected to abide by the IWC rulings. That means staying within the quotas for whales not endangered, and staying away from those species that are.

Another problem is that there are still five whaling nations[3] that have not signed the treaty. Those nations take about 10 percent of the total catch, including many whales from endangered populations. So we think it is extremely important to get these nations into the IWC.

MODERATOR: What is the United States official position on whaling?

KEN: The United States wants to end all commercial whaling.

MODERATOR: What about subsistence hunting?

KEN: The government feels subsistence hunting should be allowed to continue. That's the position it took under the Marine Mammal Protection Act of 1972, which provides for subsistence rights.

The IWC's move to limit Eskimo whaling put the U.S. in a very difficult position. On one hand, the government wants to protect the rights of minority people. On the other hand, we were afraid that if the quotas were not followed, other nations would ignore the IWC rulings.

EMILY: I remember how surprised we were in the Alaska State Legislature when the IWC extended the treaty to include subsistence hunting. Why the sudden decision?

STEVE: As a member of the IWC Scientific Committee, perhaps I should answer that. And I can assure you, it wasn't a *sudden* decision.

---

[3] Chile, Peru, Portugal, South Korea, Spain.

In the first place, scientists probably know less about the bowhead than any other species. It's just a guess, but we think there were around 16,000 in the western Arctic before the commercial hunters first came in 1848. A study of old logbooks shows that between 19,000 and 21,000 bowheads were killed before commercial whaling ended 60 years ago. And since 1931, only subsistence hunting by Natives has been permitted.

The problem was that in recent years the Eskimo hunters have been taking more and more. We warned the United States about this, but little was done. Finally in 1976, when 48 bowhead whales were killed and more than 43 were struck and lost, we decided the time had come to call a halt. And in 1977, on our recommendation, the IWC ordered an end to all bowhead hunting. At that time, we thought there were only 800 to 1,300 bowhead left.

JOHN: We couldn't believe it! No one told us the IWC was worried. If we had known, we could have taken some kind of action ourselves.

ALICE: But why did you kill so many whales? Bowheads range up to 60 feet long and weigh more than a ton a foot. Surely, your people didn't need that many.

JOHN: Our population has grown, and we have always depended on the bowhead for our physical and cultural survival. We store the meat in ice cellars dug in the permafrost, and it makes up a major portion of our year-round diet. The whaling feast is the most important celebration in our villages. And the highest honor for a man is to have a whale kill to his credit.

But I admit there were more whaling boats out that year than ever before. Some of our people who had held pipeline or construction jobs could afford to outfit a whaling boat for the first time. Many of them had not been brought up in the old ways where you start as a whale hunter's apprentice at the age of 13. And some of them did stupid things like shooting at the whale with a shoulder gun when there was no way to attach a float to the animal. Or killing a whale too far out, and having part of the meat spoil in the water before it could be towed back to shore. We didn't like those things either, I can assure you.

ALICE: Couldn't you do something about it?

JOHN: Well, after the IWC action, the whaling captains got together and formed the Alaska Eskimo Whaling Commission to develop our own management plan and spell out the responsibilities of the whaling captains. Then the U.S. delegation was able to talk the IWC into lifting the ban and giving us a quota of 12 instead. That wasn't nearly enough, and we were eating canned chicken by Thanksgiving, but it was better than nothing!

ALICE: But at what a cost! In exchange for the quota of 12 bowhead, the U.S. had to stand by while the IWC raised the North Pacific sperm whale quota to 6,500 for commercial hunters from Russia and Japan. That was nearly 10 times the quota of the year before.

JOHN: That wasn't our fault. That was the recommendation of the IWC Scientific Committee. And we Eskimos think some of those scientists don't know what they're doing unless it's playing politics.

STEVE: Now wait a minute! The bowhead is an endangered species, the sperm whale is not. You can't compare the two. A commercial harvest is acceptable if it doesn't endanger the population.

JOHN: Well, we think we know the bowhead better than anyone else. And we always believed there were more than you figured. Last spring we helped set up ice camps on St. Lawrence Island and at Point Hope, Wainwright and Barrow to count the whales on their northern migration. Now scientists agree that there are probably between 1,800 and 2,800 bowhead.

KEN: Yes. That's just a small fraction of the original population, but the bowhead does seem to be in better shape than we thought.

JOHN: Even so, we stayed within our quota. But a lot of good it did us. Last summer, we went to the IWC meeting in London to appeal their ruling on subsistence. But we weren't allowed to address the convention. We weren't even introduced. So when the IWC set a quota of only 18 whales for us this year, we walked out. And by that act, we symbolically removed ourselves from the regulations of the IWC. As I said, we will hunt by our own rules this spring. Scientists estimated the whale's reproduction rate at four percent, but to be on the safe side, we will take no more than two percent.

MIKE: But John, that reproduction rate is only a guess, and that would still be around 40 whales. You are aware of how little we know about the biology of the bowhead. We don't know about their feeding habits or their natural cause of death. We don't even know for sure where they spend the winter, although we think it's in the southwestern Bering Sea. There is still so much to be learned.

KEN: And until we do know more, we feel there must be some outside regulation, even of subsistence hunting.

JOHN: (angrily) You would think we are the only human menace to the bowhead of the Arctic. What about oil and gas industry in the Beaufort Sea? How will that affect the whales? Remember, the IWC also recommended that "all necessary measures"--and that's a quote--be taken to preserve the habitat of the bowhead. It's hard to understand how a government that seems so anxious to protect the bowhead can give the go ahead for untested Arctic oil exploration in the midst of the whale's natural habitat.

MARGARET: We in the oil and gas industry are aware of that worry, John. We're concerned with the environment, too. And we certainly don't feel that our operations are untested. We believe we are capable of operating safely in the area.

JOHN: I'm not just talking about the danger of oil spills, which is bad enough. I'm also talking about the effect of such things as noise. Eskimos have always known that the bowhead is very sensitive to sounds. We don't use outboard motors when we're stalking the whale. We approach it silently by paddling our skinboats. If you even hit the water with your paddle, the whale will disappear.

So just think what the noise from the drilling might do! It could change the whales' migration routes, disrupt their feeding and breeding activity, and further endanger the whale population.

MARGARET: The industry has spent millions of dollars on research to provide safe and economical exploration and production of oil in the state.

JOHN: Did you do any research into the effect of sound on whales?

MARGARET: Not in Alaska so far. But some work has been done on this in the Canadian Beaufort Sea...

JOHN: Then perhaps you'd better put giant mufflers on your drilling rigs.

MARGARET: Now just a minute, John. You also have to consider priorities here. The world needs new sources of gas and oil. The state of Alaska needs the income the industry pays in taxes, leases and royalties. That will amount to about $790 million this year, or more than 60 percent of the state's income. This money has helped build schools, hospitals, air strips, small boat harbors, and even this TV network which goes out to villages all over the state. And don't forget that industry and pipeline construction provided training and jobs for nearly 6,000 Native men and women in Alaska.

JOHN: The whale was here long before the money.

KEN: No one here is trying to put a dollar value on the bowhead or any of the great whales. If the largest creature ever to live on earth were allowed to perish, it would be one of the greatest wrongs we have ever done.

ALICE: Well, the commercial whalers from Japan and the Soviet Union are certainly putting a dollar value on the sperm whale--and for shoe polish, pet food, fertilizer...

STEVE: You will be happy to hear that the IWC's sperm whale quota for 1979 has been cut to 3,800--about half last year's quota.

ALICE: A commercial kill of 3,800 whales is still outrageous. And we can't understand how the U.S. got itself into the position of having to bargain for Eskimo subsistence rights with the commercial whalers who were responsible for the decline of the bowhead in the first place.

KEN: The government offered to supply the Eskimos with other red meat, free of charge, as a substitute for whale meat or to give them more food stamps...

JOHN: Just to replace the meat from those 12 whales we killed last year would cost you about $500,000. Do you want to put us on a permanent welfare? How would you like it if the Eskimos could order the rest of the nation to stop eating beef?

MODERATOR: I'm afraid we are running out of time. Perhaps we can summarize quickly where matters stand.

MIKE: We're sending a research vessel into the southwestern Bering Sea this spring to try to find out more about where the bowheads begin their migration. We hope to have data available on a full year cycle of the whale before the next Beaufort Sea oil and gas lease sale is held in December.

MARGARET: And under the federal law, that data will be taken into consideration before the leases are approved or drilling is allowed. And if it appears noise will be a problem, we are prepared to limit drilling activity to the winter months when the whales are gone.

STEVE: The IWC Scientific Committee meets again this month to draw up recommendations for the full convention. We can only hope that the Eskimos stay within the quota that has been set.

ALICE: After observing the hunt last summer, we sympathize with the Eskimos' problem. We were impressed with the difficulty of the hunt and the importance of the whale to their culture. We would be willing to support a limited subsistence hunt, so long as survival of the whale is assured.

EMILY: We will work towards a decision that balances careful conservation of whales with sensitivity to human needs. We think it would be grossly unfair to ask the Native hunters and their families to bear the entire cost of that decision.

KEN: The U.S. delegation will continue to urge the IWC to set up a separate system for regulating subsistence whaling. After all, John, the Eskimos are enjoying some of the good things of the modern world. And you have to accept some of the regulations, too.

JOHN: And we will be hunting as we said we would. We reject the idea that political nations which make up the IWC have any authority over our ancient aboriginal rights. And we will carry our case all the way to the United States Supreme Court and the World Court, if necessary.

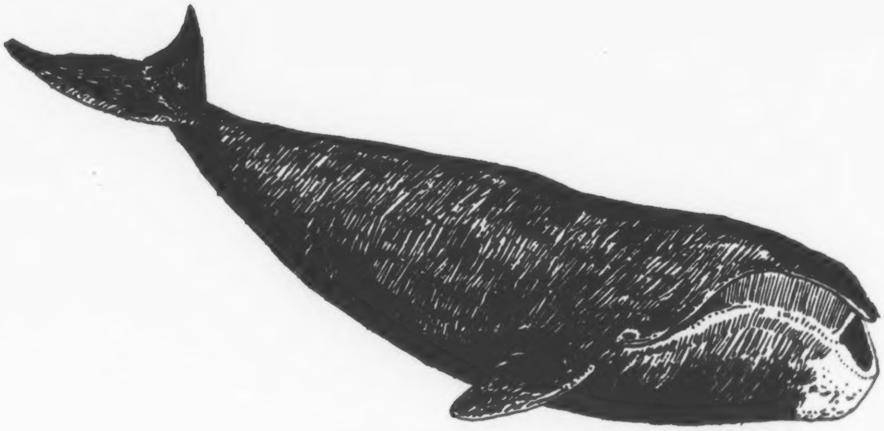
Meanwhile, I can assure you, the Eskimo will not kill the last whale.

* * * * * * * * * * * * *

The preceding article is excerpted and adapted from Alaska Tidelines (see credit at beginning).

Before this article appeared in March 1979, it was circulated for critical review of content and fairness to the Arctic Environmental Information and Data Center and the Institute of Marine Science (both University of Alaska); the Office of the Mayor, North Slope Borough; Greenpeace Alaska; Sohio Petroleum; and the Alaska Department of Fish and Game.

That is the way things stood in Spring 1979. So now you can do some updating of your own with the class. Find out: What was the bowhead whale quota for this year? How many bowhead were taken last year? What is the role of the Eskimo Whaling Commission today? What have scientific/biological studies revealed for bowhead populations over the past five years? What steps have the oil companies taken to lessen impact on the whales?



The Whale's Tail

2P

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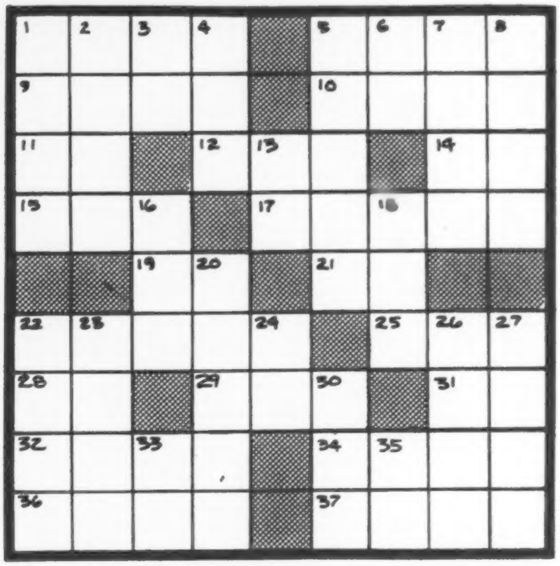


ACROSS

*1. For many years, only the Native people of Alaska have been allowed to _____ the bowhead for subsistence.
*5. In 1977, the IWC ordered the (1 across) to _____.
*9. The only whaling culture left in Alaska today is that of the northern _____ (first 4 letters).
*10. One of five commercial whaling nations that still has not joined the IWC pact.
11. As good _____ gold.
12. Great American poet and scary story writer, Edgar Allan _____.
14. Short for the middle name of (12 across).
15. Not wet, but _____.
*17. Tiny shrimp-like organisms called _____ are the main food source for baleen whales.
19. Each (abbr.)
21. Most Wanted (init.)
*22. The largest creature ever to live on earth.
25. What the crow says.
28. Short laugh.
29. Estimated Time of Arrival (abbr.).
31. Fifth letter of the alphabet - twice.
32. An island in the western Aleutians, occupied by the Japanese during World War II.
*34. The Eskimos argue that international _____ should not apply to subsistence hunting.
*36. Shelter at a whaling camp is a _____ pitched on the ice.
*37. Another word for international agreement, such as that in the IWC treaty (see 10 across for a clue).

2P

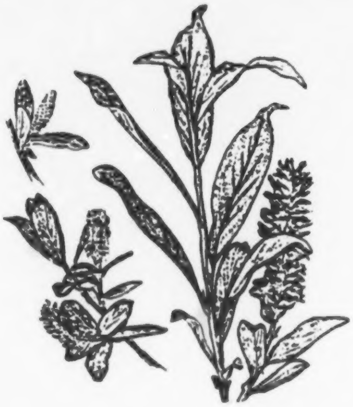
DOWN

*1. Three whales found in northern polar waters and nowhere else are the narwhal, beluga, and the bow______.
*2. A member of the IWC, but still one of the largest commercial whaling nations.
3. North Korea (init.)
4. The part of the iceberg you see.
*5. When the IWC set a quota of 12 bowheads for Eskimo subsistence hunters, it also allowed commercial whalers to take 6,500 _____ whales.
6. Too easy (init.)
7. Not written, but spoken - as in an _____ test.
*8. It takes a lot of teamwork to _____ a whale up onto the ice.
13. Modern slang for "All right."
16. Biblical word for "All right."
*18. International group formed to conserve the whales and control commercial whaling (init.)
*20. Once a great whaling culture, the _____ people no longer hunt whales for subsistence.
22. Who? _____? Where? Why?
23. Some people _____ spinach.
24. Latin for "and."
*26. Eskimo group formed to regulate their own whale hunt (init.).
*27. No one knows for sure, but the bowheads are believed to spend the winter in the south_____ Bering Sea.
30. High mountain (think of Switzerland).
*33. Bowheads weight over a _____ (abbr.) a foot.
35. Alaska Airlines (init.)

Do You Know Your Trees and Shrubs? 3A

Directions: Cut out and match the numbered pictures with the descriptions. Then make flash cards!

1.



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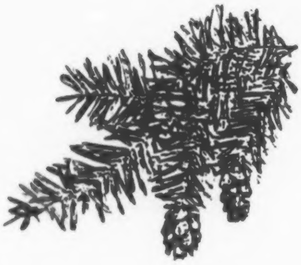

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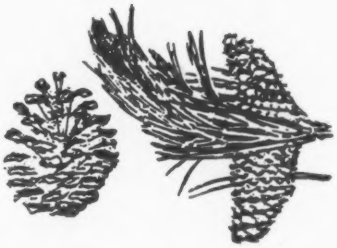

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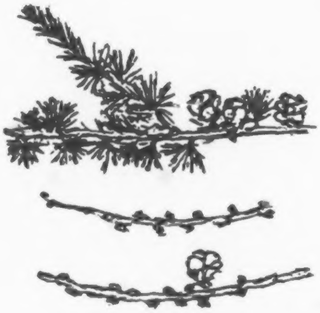

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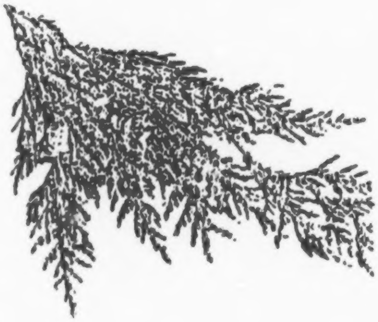

3A

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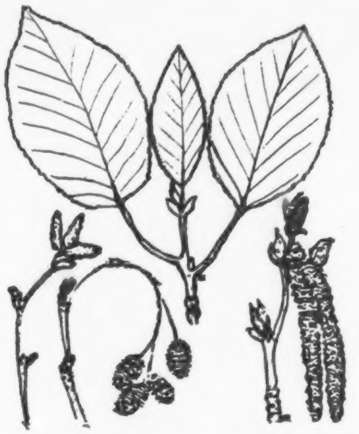

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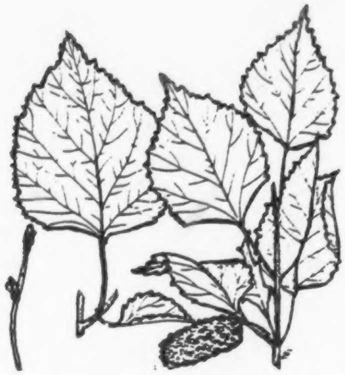

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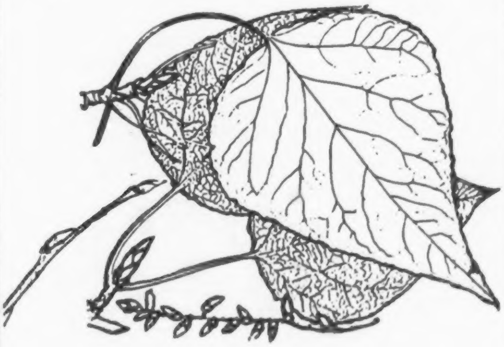

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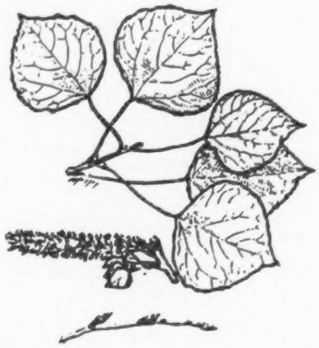

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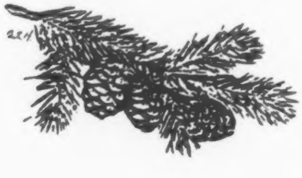

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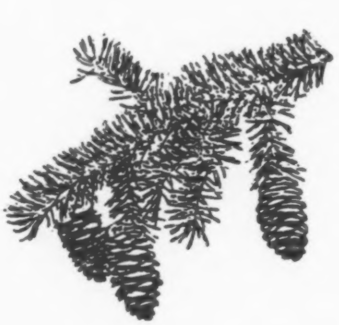

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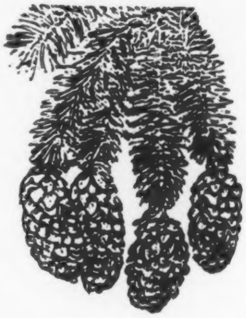
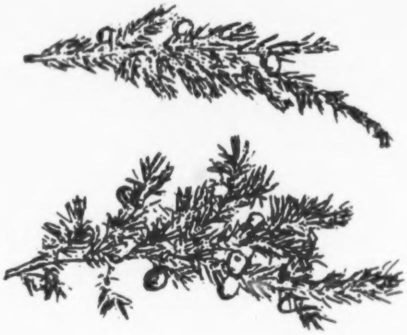


JUNIPER - low, spreading evergreen shrub, leaves in groups of three; most widely distributed conifer in the world.

ASPEN - leaves with slender, flat stems; smooth whitish or greenish gray bark.

13.



TAMARACK - small to medium-sized Interior deciduous tree with clusters of needles on very short branches; also called larch or hackmatack.

ALASKA CEDAR - medium-sized evergreen found in Southeast and southcoastal Alaska; scale-like leaves; short, almost round cones; similar western red cedar found in southern Southeast Alaska.

LODGEPOLE PINE - small to large Southeast evergreen; needles often twisted two to a bundle; egg-shaped cones 1¼ to 2 inches long.

POPLAR OR COTTONWOOD - medium to large deciduous tree with large, almost heart-shaped leaves; balsam poplar found in most of state except Southeast; black cottonwood found in Southeast and southcoastal, both species called poplar or cottonwood.

WILLOW - 33 deciduous species in Alaska ranging from tiny tundra shrubs to small trees; long, narrow leaves; seeds in catkins.

BIRCH - 2 deciduous shrub and 3 tree species in Alaska; the shrubs have round toothed leaves, and the trees have pointed toothed leaves; bark of paper birch used for canoes, baskets, tinder.

ALDER - 4 deciduous species - 3 of which reach tree size; long male catkins; short female catkins; seeds in small, round cone-like structures; alder roots fix nitrogen from the air and enrich the soil.

BLACK SPRUCE - small, Interior coniferous tree; short sparse branches, short pointed needles; small, short, egg-shaped cones hanging downward, generally found in bogs and moist areas.

WHITE SPRUCE - medium to large-sized Interior conifer; short-stalked needles; cylindrical cones hanging down; skunk-like odor when twigs and needles are crushed; grows on well-drained sites.

WESTERN HEMLOCK - large conifer with soft, flat needles; small 5/8 to 1 inch cones hanging down; the similar mountain hemlock is gnarled and twisted and much smaller.

SITKA SPRUCE - large to very large Southeast and south-coastal conifer; short-pointed needles; 2 to 3½ inch cones hanging down; State Tree.

3B

Wood and Wood Products Inventory

WOOD AND WOOD PRODUCTS INVENTORY

What products of trees are found in and around your house?

	NAME OF ITEM	USE	ORIGIN (IF KNOWN)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
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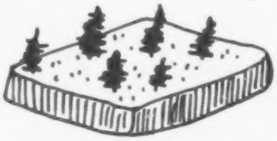
17.			
18.			
19.			
20.			
21.			
22.			
23.			

Log Those Trees

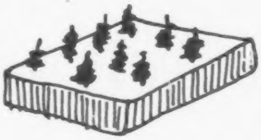
3C

There are three types of logging: clearcutting, seed tree selection, and single tree selection. Read the descriptions and fill in these terms. (Hint: the blanks in the description have the same word roots as the type of cutting.)

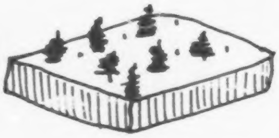
1. ______________



A large area is cleared leaving well-spaced ______________ trees. Sometimes fertilizer is added to speed growth.

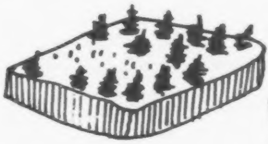


When new growth is established, the ______________ trees are cut.

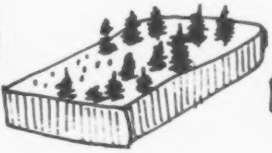


Some of the trees may need to be thinned (cut down) to promote vigorous growth of the trees that are left.

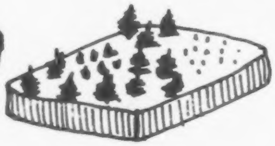
2. ______________



One area is cleared completely.

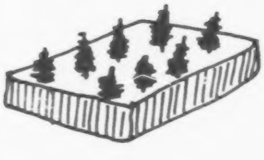


The __________ area can be planted with young trees or left to reseed from adjacent trees.

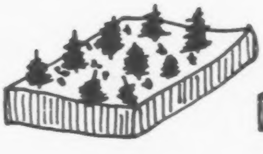


Once the __________ block begins to grow, another nearby area can be cut.

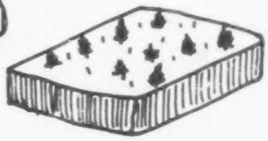
3. ______________



Selected trees of various ages are cut, leaving a thinner but even-aged forest.



Natural reseeding occurs. But additional planting may be necessary.



When the young growth is well-established, the older trees can be cut.

4. Both numbers _____ and _____ above are types of selecting cutting because ____.

5. Trees need light, water, sun, nutrients and space to grow rapidly. Sometimes foresters will thin a forest to help the best-looking trees grow faster. Thinning means _________ ____.

6. Trees are a renewable resource because __________________ ____.

7. Foresters have to figure out the sustained yield for the forest, or how much can be harvested year after year so that there will still be trees for future generations. The amount of lumber that can be cut in any one year is called the allowable cut. Use these two underlined terms in a sentence to show that you know what they mean.

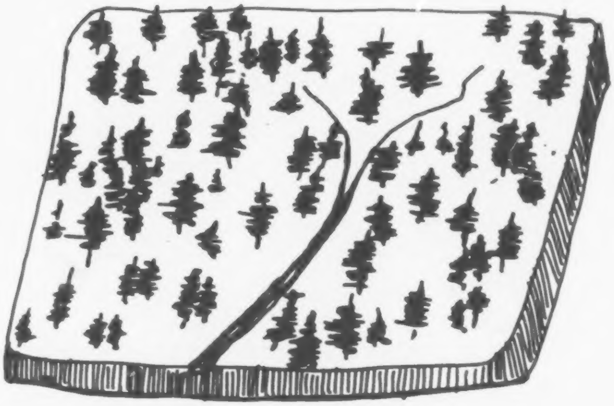
____

____

____.

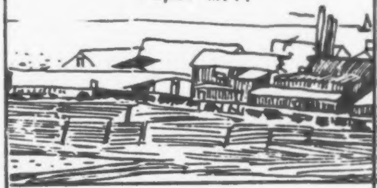
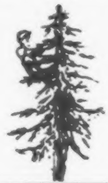
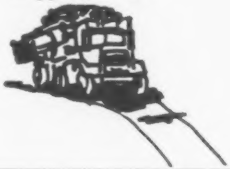
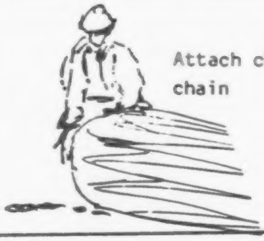
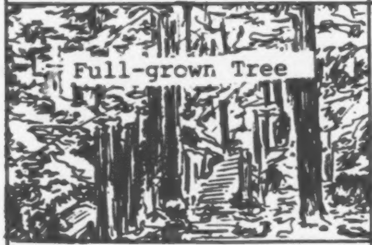
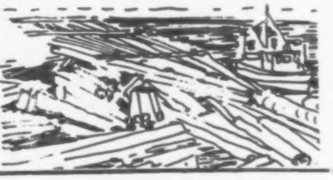
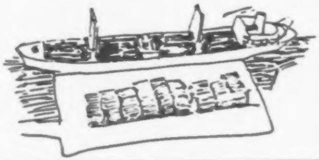
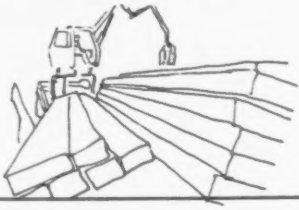
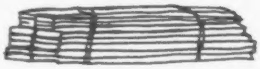
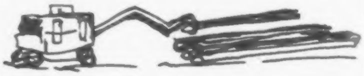
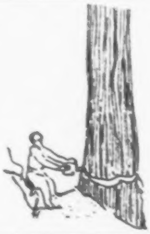
8. One of the main problems with logging is that it creates soil erosion. If topsoil is lost, new trees have difficulty finding a good place to grow.

This area is part of a proposed clearcut. Circle the trees you would leave so that there will be only minor soil erosion.



From Seed to Lumber and Pulp

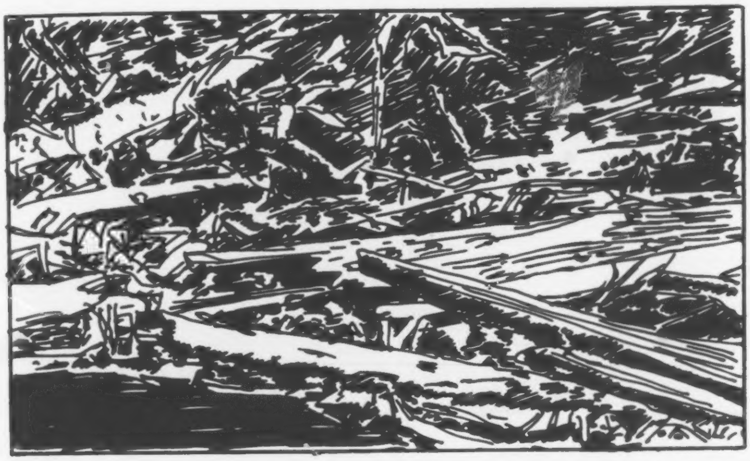
Directions: Tear apart these squares and place them in the proper sequence on another piece of paper--drawing arrows from one to another. (Hint: There are several different routes.)

Paper mill 	Pulp 	Trim branches and top 
Book Store Office Supplies Grocery Store Lumber Store	Tree seeds 	Logging truck 
Scrap lumber 	Your summer job planting trees (draw a picture)	 Attach choker chain
 Full-grown Tree	Log boom 	Off to Japan 
Tree seedling 	Lumber and pulp mill 	Lumber 
Your house (draw a picture)	Skidder hauls to road or tidewater 	 Timber!

3E As A Fisheries Biologist

You've just landed a job as a fisheries biologist for the U.S. Forest Service. Your first assignment is to help set up a timber sale. You need to draw up a list of practices that will help protect fish habitat during and after logging.

Here is some information from the Logging and Fish Habitat pamphlet you found on your desk, which may help:



Debris in Streams

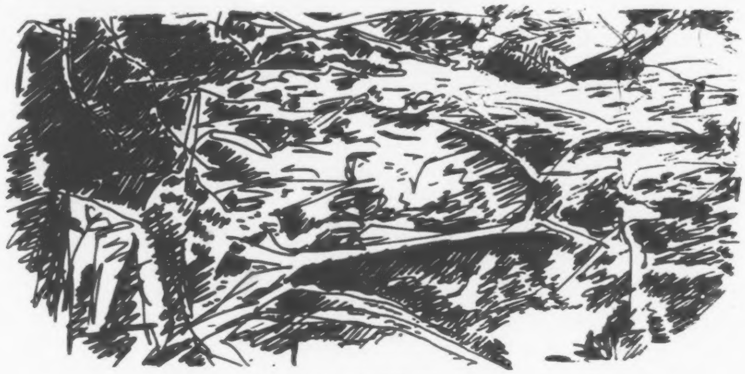
Excessive debris in streams can lower the quality of natural stream habitat by forcing streams underground, with resultant loss of rearing and wintering areas. It also blocks adult fish passage and covers suitable spawning beds. Small streams dammed up by logging debris can experience increased water temperatures and reduced oxygen levels. Both may be lethal to fish.

Debris such as bark, needles and small twigs covering the streambed reduces the abundance and variety of insects, thus limiting the capability of streams to support young fish.

Falling and yarding timber away from streams or leaving a fringe of windfirm timber along the streams are ways of avoiding debris in streams.

Stream Cleanup of Logging Debris

If debris and logs do end up in the stream, prompt cleanup is usually necessary to avoid the problems to fish habitat that can result from logs and slash in streams. The best method of protecting a stream is to keep logging debris out of it in the first place. Natural debris in streams that has become a part of the stream environment and is not a block to fish passage should be left in place. For instance, some logs not creating blocks should be left in place, to afford protection from predators for the young and adult fish in the stream. Although timber sale contracts call for removal of any trees that are dropped into streams, blowdown logs across a stream or those logs that have become partially buried in a stream usually should be left in place by a stream clearing crew--as long as the logs do not create an obvious block to fish passage.



Bank Damage

Stream banks can be damaged by yarding logs from or across the stream, by locating roads too close to the water, or by equipment improperly crossing or working in the stream.

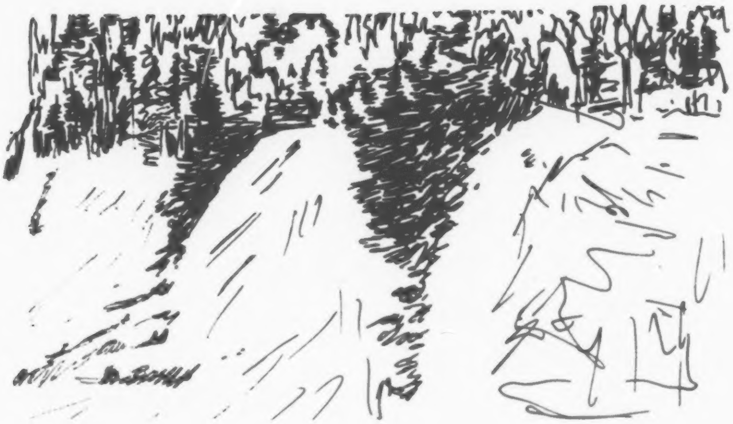
Equipment improperly crossing small streams can often cause the stream to spread out. If this occurs, the stream may be forced underground at low flow, resulting in a blockage to fish as well as a loss of habitat.

Damage to stream banks can be minimized by yarding logs fully suspended above the stream, by using proper stream crossing structures, by orienting road-crossings at right angles to streams, by restricting equipment use in streams, and by leaving a timber screen between the road and the stream if the situation is critical enough to warrant it. In short, stream banks should be left intact if development activity is taking place in the area.

Sedimentation

Many potential sources of sedimentation exist. V-notches and roads are just two examples. Numerous V-notches are encountered in logging areas of southeastern Alaska. These V-notches result from old or current streambeds, and are generally unstable and steep.

If they become clogged with debris or are otherwise disturbed, the potential for soil sliding and erosion increases. Sedimentation from V-notches can be minimized by restricting cutting in critical areas, and by full suspension of the logs while yarding in or near the V-notch.

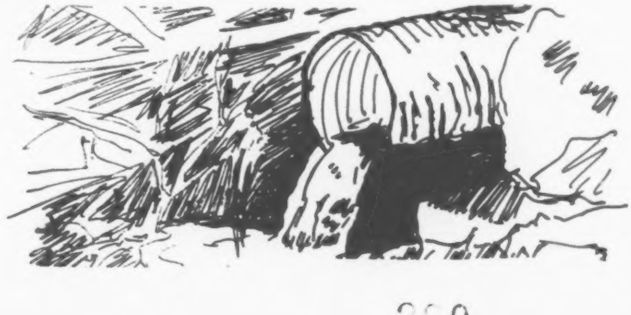


Roads may expose some bare soil to erosion. This erosion can occur on cut slopes, ditchlines, or from sidecast or wasted material. The type of soil, the steepness of slopes and the steepness of road grades all influence erosion potential. Properly engineered road grades, alignment, cut slopes, waste areas, and culverts or cross drains will minimize the amount of sediment from roads. Maintenance can be just as critical as the initial construction. Revegetated slopes will decrease the area of bare soil subject to erosion. Natural "filter strips" between streams and roads can allow removal of much of the sediment carried by ditch runoff before it can enter the streams. On extremely steep slopes, completely avoid logging and its accompanying roads.

Blocked Fish Passage

Poor culvert installation can block fish passage, thereby eliminating upstream rearing areas for young fish as well as upstream spawning areas for migrating adult fish. Blockage occurs when the culvert outlet is inaccessible, or the culvert is too steep or too small. Culverts should be removed from abandoned roads.

Fish passage can be maintained by installing properly engineered culverts, and by excavating to the natural streambed when removing culverts. The velocity of water flowing through a culvert, which allows salmonids to move upstream, should be no greater than 1.3 feet per second.



Now, write some guidelines for the timber sale that will protect the fish habitat.

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

6. ____________________

7. ____________________

8. ____________________

9. ____________________

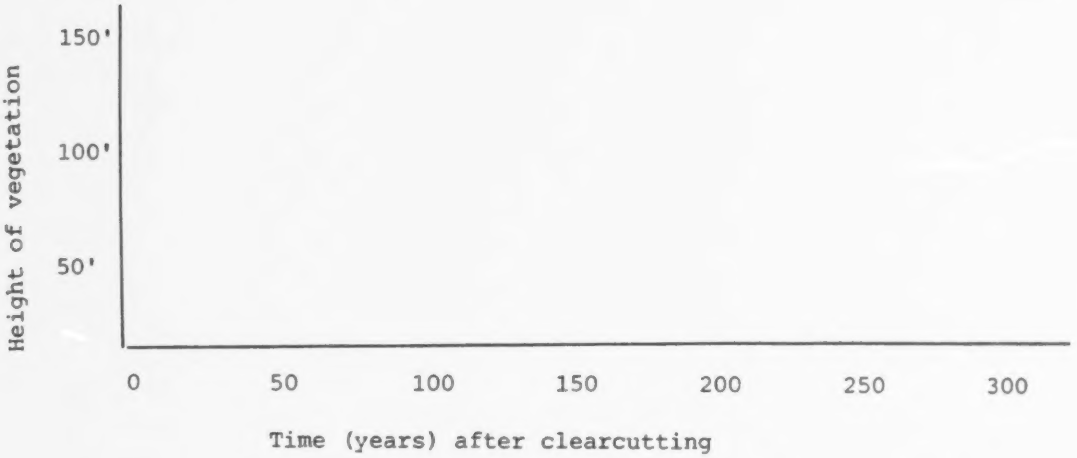
10. ____________________

11. ____________________

And be sure to visit the proposed timber sale site to see if there are any site-specific rules that should be followed.

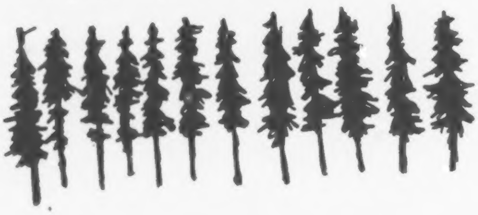
3F Graphing Deer Use of Clear Cuts

1. All plant communities are constantly growing and changing until they reach their climax stage of vegetation. Draw this succession in a Southeast Alaska forest after a clearcut.

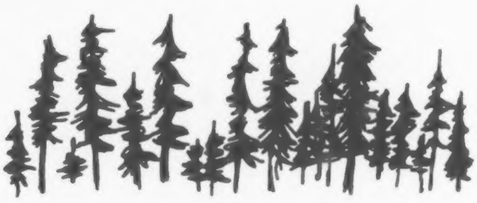


Year
before cut = old-growth forest (height variable to 150')
0 = clearcut (height = 0)
50 = grass, shrubs and seedlings (height 25-50')
100 = trees (height = 75-100')
150 = trees (height = 100-125')
200 = trees (height = 125-150')
250 = trees (height variable to 150')
300 = trees (height variable to 150')

2. Here are two drawings of an even-aged stand of trees and an uneven-aged stand of trees.



even-aged forest
(70 years old)

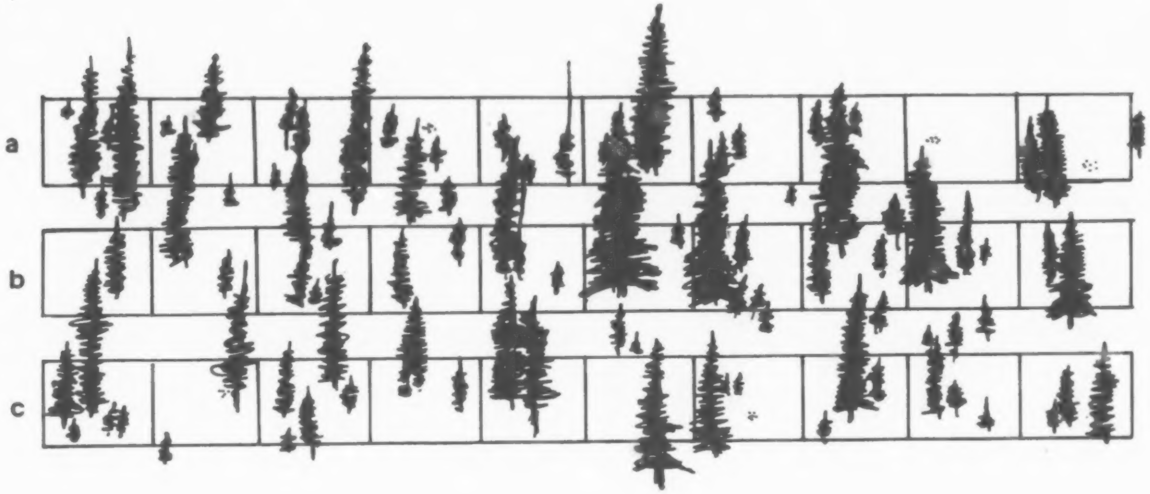


uneven-aged forest
(300 years old)

a. Which stand has the most diversity? ________________

b. Which stand has the most deer food? ________________

3. To discover deer use of clearcuts and old-growth forests, biologists counted pellet groups in 1x10 meter belt transects. Here are some transects that were set up in an old-growth forest. Count the pellet groups in these three belt transects.



How many pellet groups are in belt transect A? _______ (a)

in belt transect B? _______ (b)

in belt transect C? _______ (c)

What is the average number of pellet groups for each one meter square plot? _______ (d)

Biologists list their results in numbers of pellet groups per hectare. A hectare is 100 meters x 100 meters. What is the average number of pellet groups per hectare in this old-growth forest example? _______ (e)

4. Here are the biologists' results in clearcuts and adjacent old-growth forests. They generally sampled 6 transects of 50 plots in each area.

3F

4. Here are the biologists' results in clearcuts and adjacent old-growth forests. They generally sampled 6 transects of 50 plots in each area.

		Fall Groups/ha		Spring Groups/ha	
Area number	Age of clearcut	new growth (clearcut)	old growth	new growth (clearcut)	old growth
1	0			0	383
2	4	91	300	187	643
3	6 - 10	350	602	343	1,223
4	7 - 10	109	717	323	1,090
5	13			137	1,370
6	20	30	141		
7	25	125	283		
8	30 - 34			390	1,667
9	30 - 34	168	696	63	837
10	33 - 37			217	1,057
11	53			43	1,570
12	57	34	736		
13	58	20	577	20	1,920
14	60	75	602	223	1,223
15	63	147	540	97	880
16	64			187	1,090
17	72	43	684	57	1,017
18	85 (burn)	62	577	90	1,570
19	112	85	185	287	1,570
20	147 (burn)	50	340	217	1,387

What is the average of the fall clearcut pellet densities?

________ (a)

...fall old-growth pellet densities?

________ (b)

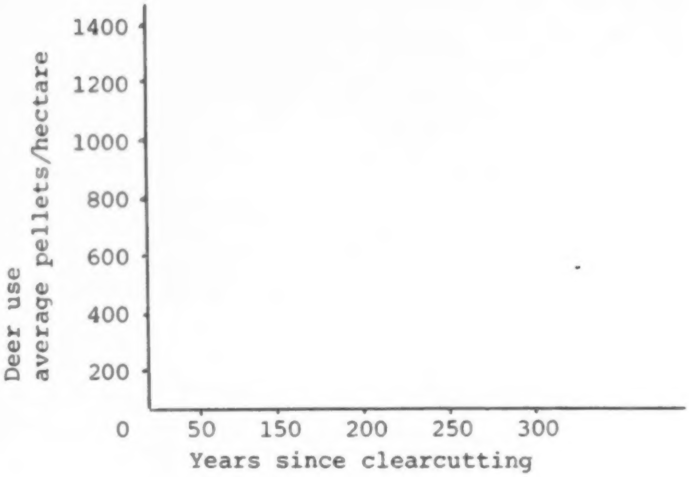
...spring clearcut pellet densities?

________ (c)

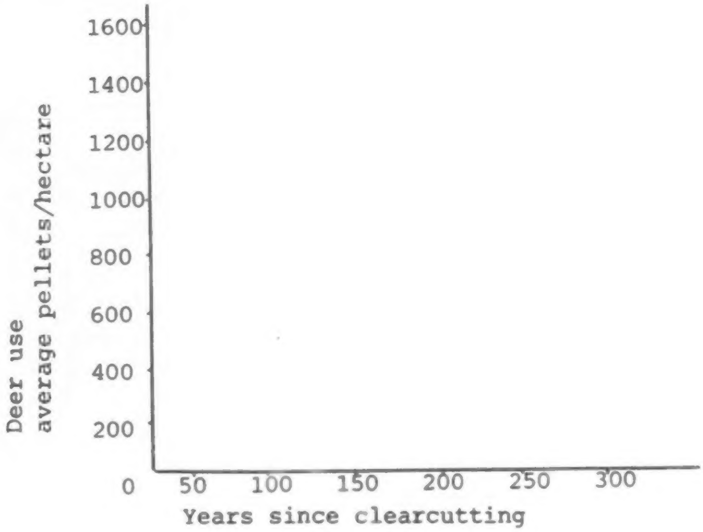
...spring old-growth pellet densities?

________ (d)

Graph the fall clear-cut use by deer. (Use your average fall old-growth pellet density (b) for the 300-year figures.) (e)



Graph the spring clear-cut use by deer. Use your average old-growth pellet density (d) for the 300-year figure.) (f)



5. Read your graphs to figure out at what age forests reach their climax, or old-growth, stage.

____

6. The present Tongass National Forest policy allows for timber harvesting every 100 years in an area. Go back and mark the 100-year rotation on each of your three graphs. If the forests continue to be cut every hundred years, what will this mean to deer populations in Southeast Alaska?

____

____

____

3G Birds in the Old-Growth Forest

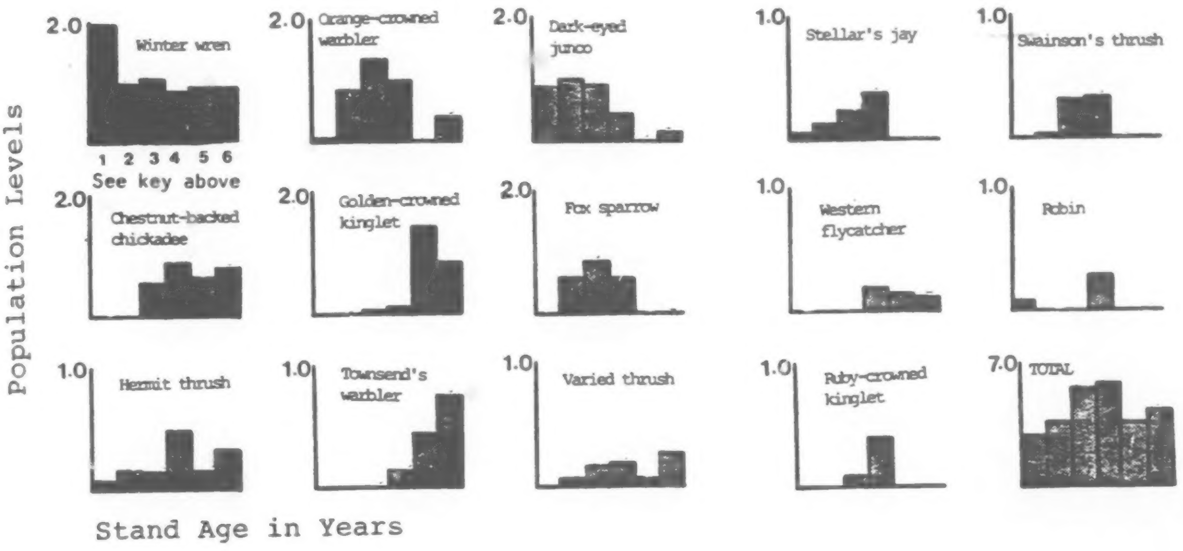
The best way to find out what happened in a research project is to look at the data and interpret it for yourself. Here is some information from a pamphlet by Dr. Winifred Kessler entitled Bird Population Responses to Clearcutting in the Tongass National Forest of Southeast Alaska, published by the U.S. Forest Service. It studies breeding bird populations in the Tongass, which is the largest national forest in the United States. Forestry practices bring about major, long-lasting habitat changes and this study was done to find out what the effects are on different species of nongame birds.

The study was done on Kosciusco Island. Most of the trees are western hemlock and Sitka spruce. Much of the island has been clearcut so there is great variety in the age of stands there. Dr. Kessler studied bird use in six stands of different successional stages:

Key: 1. Recent clearcut, less than 5 years;
2. Shrub/sapling, 11 years;
3. Sapling/shrub, 17 years;
4. Pole trees, 30 years;
5. Young sawtimber, 80 years; and
6. Old growtn, well over 150 years.

Dr. Kessler and her assistant laid out four 300-meter transects in each stand. They walked each transect 12 times over a period of seven weeks from May 30 to July 17, 1978. At every 20 meters, they would stop and listen for five minutes, recording birds seen or heard along the transect.

Here are simplified graphs of some of their results:



The first 14 graphs show population levels of the forest's most common species in six stages of hemlock/spruce forest during summer 1978, Kosciusko Island, Alaska. The last graph shows the total population level of birds in each stand. The population level is defined by Dr. Kessler as the "mean number of bird observations per transect per visit." For example, winter wrens were counted along the four transects in each stand on each of the 12 visits, so there were 48 wren counts to use in figuring the mean for each stand. In the "recent clearcut, less than five years" stand, the mean turned out to the 1.89--that is, there was an average of 1.89 winter wrens observed at each transect on each visit. This shows up on the winter wren graph as a bar very close to the 2.0 mark.

1. Which populations of birds are greater in the 11-year stand than in the old-growth forest? Which are smaller? (Tiny changes in the bars don't count in this kind of study.)

2. What is the most common bird in the recent clearcut stand? In the sapling/shrub 17-year stand? In the 80-year saw-timber stand?

3. Which two species would have the most trouble if there were no forests 80 years or older?

4. Is the total population of birds highest in a newly cut stand, a midsuccessional stand, or in the old-growth forest?

5. Would the total population be highest in the same successional stage if the study were done elsewhere?

6. In the 80-year stand, there is not much shrubbery because the treetops form a thick canopy that blocks out light from the forest floor. There is a much greater variety of plants both in the younger stands and in the old-growth stand. How might this effect bird populations in the 80-year stand?

7. Here is another table from Dr. Kessler's report. It includes the birds on the graphs and several less common species. For this table, birds listed as increased by clearcutting are those that are considerably more numerous in one or more stages of forest succession than in the old-growth forest. Species listed as decreased by clearcutting are those that are absent or rare in some of the stages after logging. Those for which this study did not provide sufficient data are listed as inconclusive.

> It is important to note that some species dependent on old-growth may not be listed at all either because of nocturnal habits or because they are so rare and have such broad ranges that they may be present in the forest but never have been in the study area while counts were taken. These species include the goshawk, great gray owl, pygmy owl, northern three-toed woodpecker and several others. Most of them are cavity nesters, dependent on snags which are present--unless there is a policy of saving them during logging--only in old-growth forests.

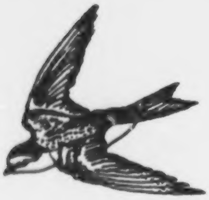
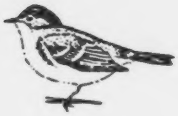
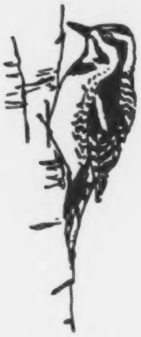
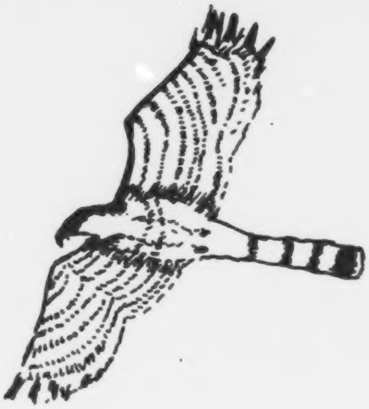
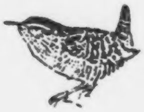
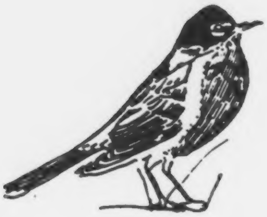
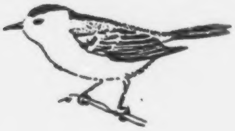
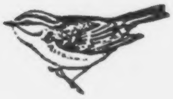
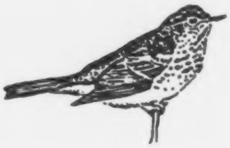
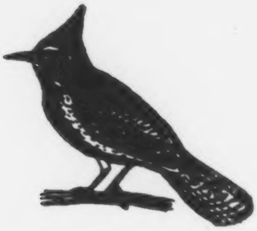
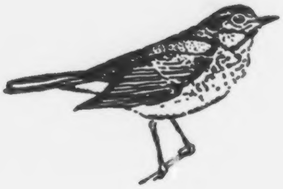
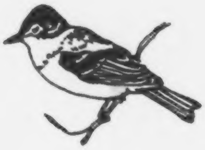
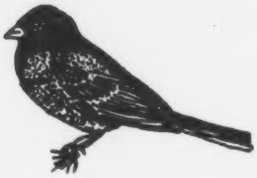
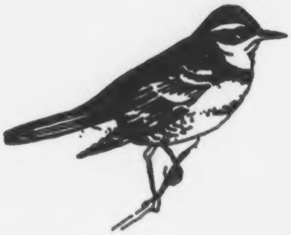
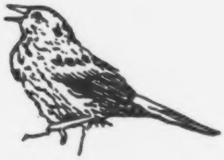
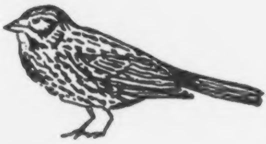
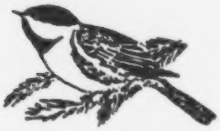
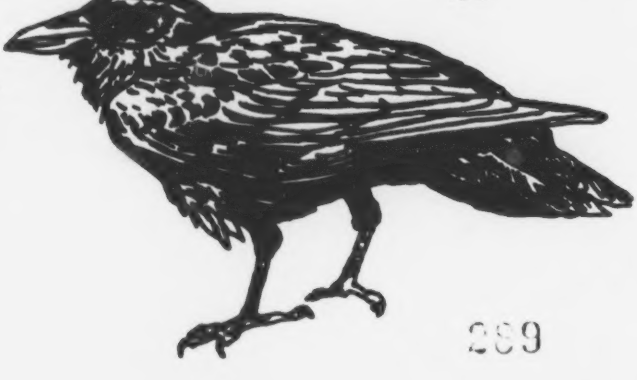
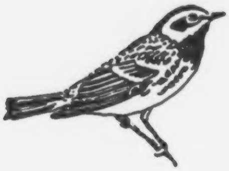
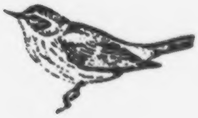
Cut the pictures from the following page and place them under the proper columns. Use a field guide to help you. As you identify each bird, write down what type of habitat it nests in. Circle the 14 most common species, those listed in the previous chart.

Table 14. Effects of clearcutting on populations of bird species observed in logged and unlogged hemlock/spruce forest, Kosciusko Island, Alaska.

BIRD SPECIES POPULATIONS

Increased by clearcutting	Decreased by clearcutting	Inconclusive
Winter wren	Chestnut-backed chickadee	Tree swallow
Orange-crowned warbler	Golden-crowned kinglet	Wilson's warbler
Darkeyed junco	Townsend's warbler	Common raven
Fox sparrow	Varied thrush	Sharp-shinned hawk
Steller's jay	Western flycatcher	
Swainson's thrush	Yellow-bellied sapsucker	
Ruby-crowned kinglet		
American robin		
Song sparrow		
Hermit thrush		

3G

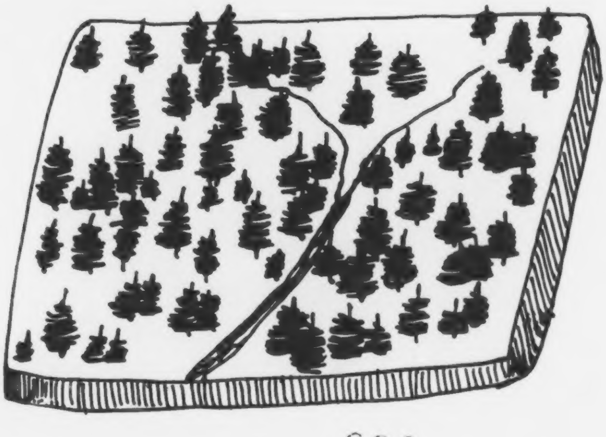
8. Where do most of the birds found in the old-growth forest nest?

9. The following year, Dr. Kessler ran transects along streams and forest edges in both clearcuts and old-growth forests. Do you think she found more or fewer birds during the second study?

An important ecological fact is that wildlife tends to be most dense and diverse around bodies of water such as streams and along habitat edges between, for example, a forest and a meadow. So if you guessed that Dr. Kessler found more birds the second year you were correct. Dr. Kessler went on to say that stream habitats in Southeast Alaska seem especially important for cavity-nesting species. I found much greater abundance of these birds (such as woodpeckers, tree swallows, chickadees) along riparian areas. I also found species that show strong preference for riparian zones (song sparrows, western flycatchers, Lincoln's sparrows)."

a. Just from your reading, what would you guess that "riparian" means?

b. Design a clearcutting plan for the drawing below that affect relatively few birds and animals. Circle the trees you would cut.



c. This time Dr. Kessler had enough observations to show that tree swallows increased with clearcutting, and that Wilson's warblers, the common ravens, and sharp-shinned hawks all decreased. Make the corrections by drawing arrows on your question no. 6.

d. Write down some questions of your own on the effects of clearcutting on birds, and then design a study to answer those questions.

3H

Save that Snag!

One way that loggers can help preserve bird use of an area is by leaving snags. Figure out some of the reasons by matching these descriptions with the following pictures and placing them in the proper sequence.

1. At full maturity, a 300-year-old conifer provides nesting habitat for some bird species.

2. In and under the mushy remains of the old log, insects, snails and other small creatures find food and a good place to hide until woodpeckers and other birds begin to pick at them among the tree's rubble.

3. After the tree dies, bare branches provide perches for predators. A red-tailed hawk replaces the eagle atop the increasingly fragile crown.

4. After lightning and wind further break up the snag, other cavity nesters, such as downy woodpeckers, move in. Researchers have found that even snags that appear to be falling down are valuable for nesting.

5. As the bark loosens, foraging becomes easier for woodland species such as the brown creeper. Using its tail as a prop, the bird moves up and around a tree, searching for insects. Both brown creepers and winter wrens nest behind pieces of bark that curl out from the tree. Bats are also common around the dead tree at this stage.

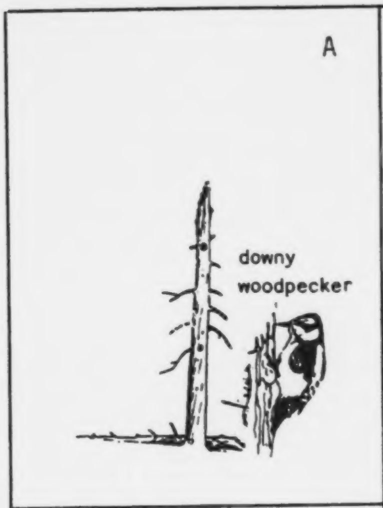
6. Stripped clean, the bleached snag becomes an attractive nesting site for strong-billed woodpeckers. Their holes later provide homesites for other animals. Such creatures as flying squirrels, chickadees, and flickers often choose to live in these abandoned holes.

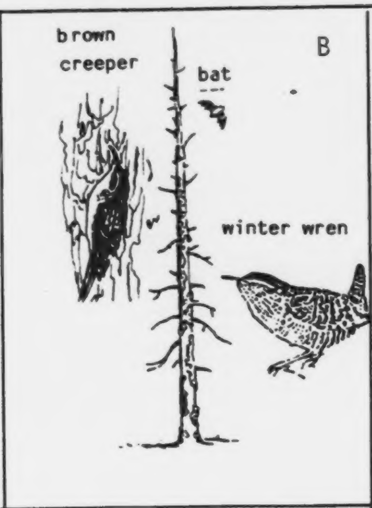
7. A century or more after the mature tree began to deteriorate, its insect-ridden stump remains a good food source for some wildlife. As it continues to break down into the soil, new trees sprout and the entire cycle begins anew.

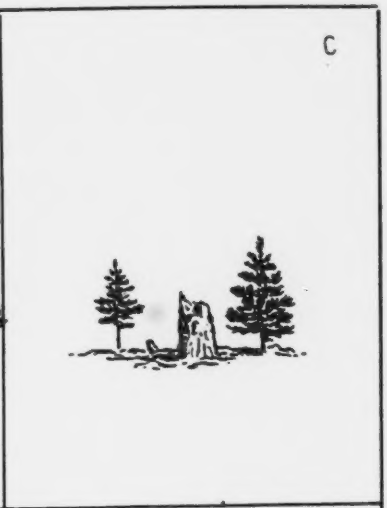
8. Decomposed, soft and now heavily riddled with holes, the snag becomes a shelter for songbirds that lack the woodpecker's strong beak. With more passageways available for non-boring insects, invertebrate life becomes more diversified.

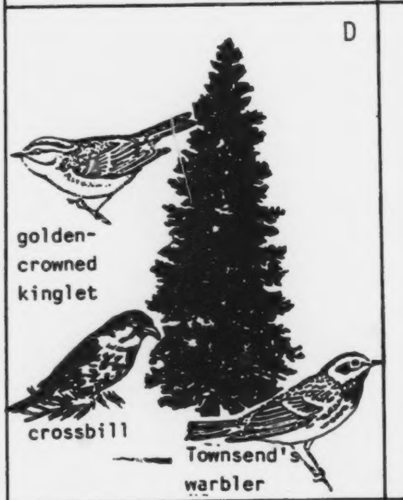
9. Eventually, the aging tree is attacked by diseases, fungi and boring insects. The insects attract small birds and the tree's crown is still strong enough to support an eagle's heavy nest.

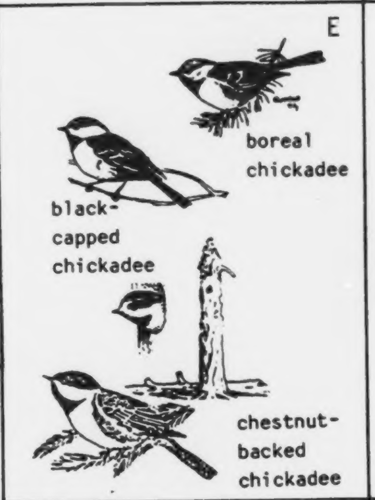
3H

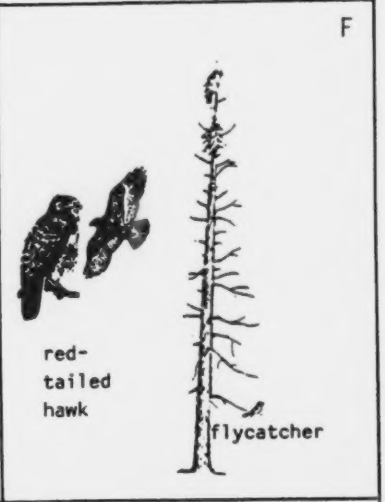

A
downy woodpecker

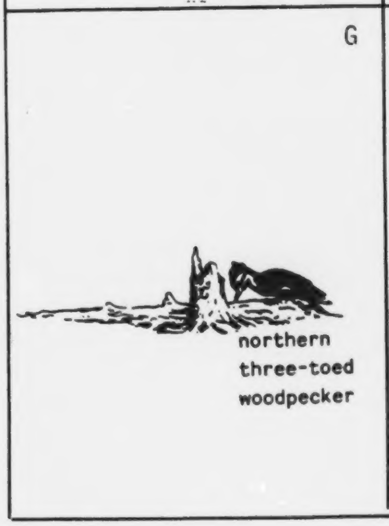

brown creeper
bat
B
winter wren

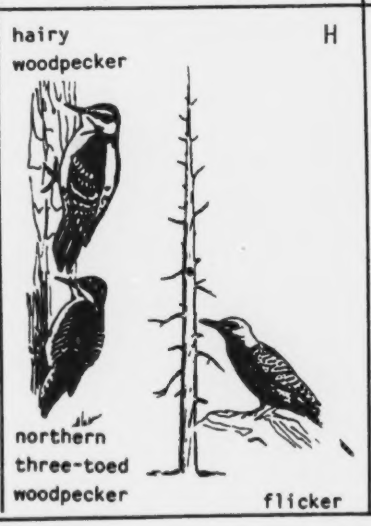

C

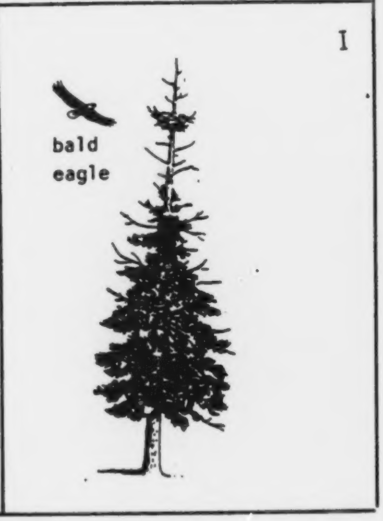

D
golden-crowned kinglet
crossbill
Townsend's warbler


E
boreal chickadee
black-capped chickadee
chestnut-backed chickadee


F
red-tailed hawk
flycatcher


G
northern three-toed woodpecker


hairy woodpecker
H
northern three-toed woodpecker
flicker


I
bald eagle

Comparing Stumps and Trees

What differences did you notice?

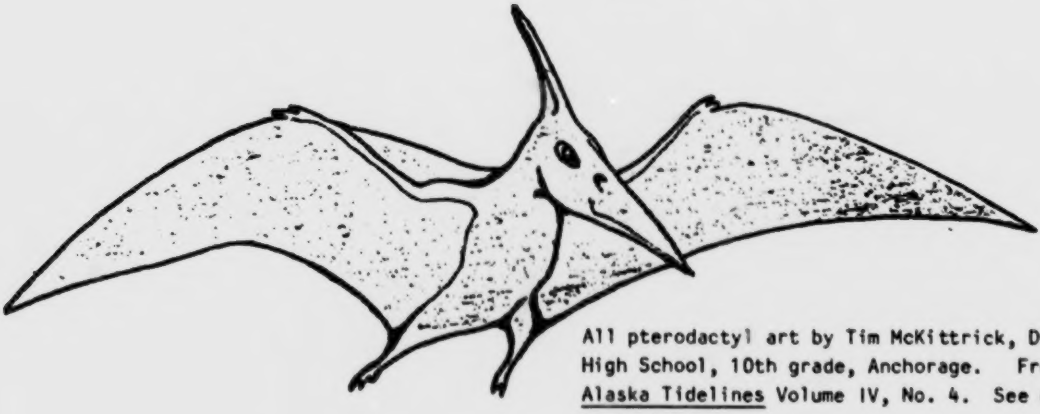
	CLEARCUT			OLD GROWTH		
Stream conditions						
Fish signs or sightings						
Animal signs or sightings						
Bird signs or sightings						
Temperatures	soil	water	air	soil	water	air
Insects						
Trees and other plant species and heights						

4A

From Pterodactyls to Petroleum

How well can you predict the connections between pterodactyls and petroleum? Read the statements and write true or false in this handy prediction guide, then read the information and correct your guesses.

Your Prediction	Actual		
________	________	1.	Some pterodactyls were as big as small planes.
________	________	2.	At one time all of Alaska was under water.
________	________	3.	Tremendous pressures changed the silt, sand and clay sediments into oil.
________	________	4.	Petroleum means "rock oil."
________	________	5.	Petroleum lies in great underground lakes.
________	________	6.	To find oil, scientists look for sedimentary rocks.
________	________	7.	Only one out of 20 wells drilled have produced enough oil to be profitable.
________	________	8.	Special mud is used in the drilling operation.
________	________	9.	Once oil is struck, it always has to be pumped out of the ground.



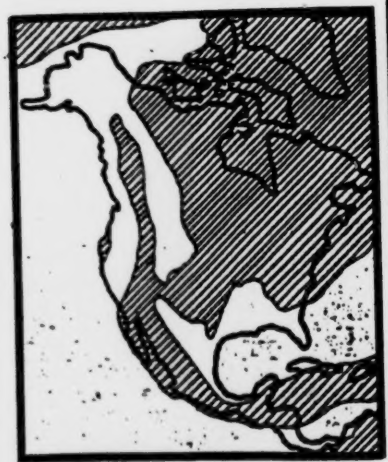
All pterodactyl art by Tim McKittrick, Dimond High School, 10th grade, Anchorage. From Alaska Tidelines Volume IV, No. 4. See credit on next page.

"FROM PTERODACTYLS TO PETROLEUM" and "WHERE DOES THE OIL GO?" are excerpted and adapted from Alaska Tidelines, Volume IV, Number 4, December 1981/January 1982. Virginia Sims, editor. Copyright © 1981, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509, to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice, and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

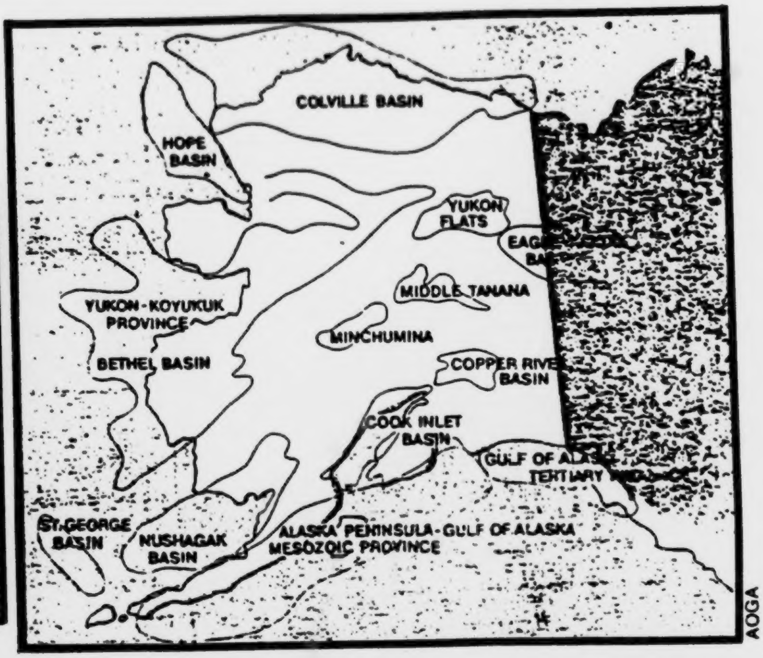
WHERE DID OIL COME FROM?

Start with this far-out flying reptile, which glided around in prehistoric times on wings made of skin attached to long-fingered arms in the best TV Batman fashion. It had a pointy head and a nose like a beak. And fossils show that it ranged from the size of a small sparrow to that of a giant with a wing-span like a Piper Cub. Its scientific name is pterodactyl (tair-oh-DACK-til), from the Greek petron meaning "wing" and dactylos meaning "finger."

In pterodactyl's day--say, 150 million to 65 million years ago--a warm, shallow sea stretched from what is now the Arctic coast of Alaska almost to the Gulf of Mexico (see Map #1). As zillions of generations of pterodactyls, along with countless other forms of plant and animal life, lived and died over that enormous time span, their remains settled to the bottom of the ancient sea. There they were broken down by bacteria and covered over by silt, sand and clay.



MAP #1: This is the way the North American continent is believed to have looked around 100 million years ago when much of the land was flooded by shallow inland seas.


COLVILLE BASIN
HOPE BASIN
YUKON FLATS
MIDDLE TANANA
YUKON-KOYUKUK PROVINCE
MINCHUMINA
BETHEL BASIN
COPPER RIVE BASIN
COOK INLET BASIN
GULF OF ALA TERTIARY
ST. GEORGE BASIN
NUSHAGAK BASIN
ALASKA PENINSULA-GULF OF ALASKA MESOZOIC PROVINCE

AOGA

MAP #2: Beneath the ancient seafloors, deep basins were formed by layers of sediment and decaying plant and animal life. This map shows 14 such sedimentary basins in Alaska that are of special interest to oil geologists.

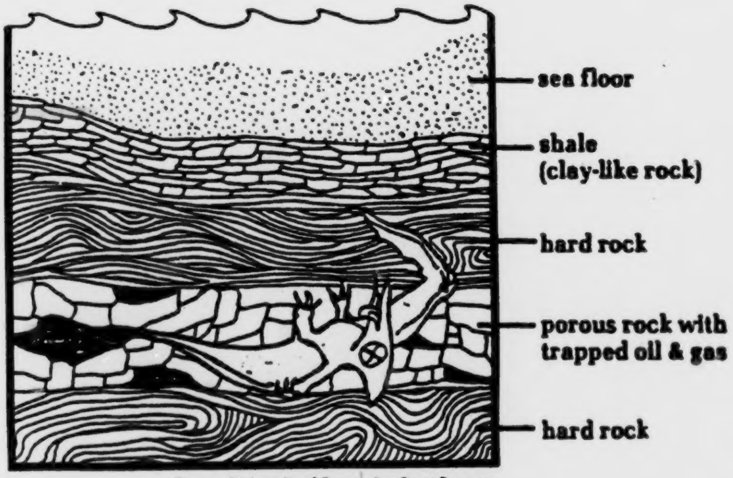
Over the ages, layer upon layer of decaying material and debris crushed down upon each other, forming what are called sedimentary basins, thousands of feet deep (see Map #2). And in some mysterious way (which we still don't really understand and have never been able to copy), the great pressure, heat and dampness changed the once-living remains of pterodactyl and his like into oil and natural gas, while the silt, sand and clay were molded into rock. So the right name for the kind of oil we're talking about is petroleum (puh-TROH-lee-um), which comes from the Latin petra, meaning "rock," and oleum, meaning "oil."

HOW DO YOU FIND IT?

When you hear about oil "pools" and "reservoirs" (or oil "wells" for that matter), you might get the idea that petroleum lies in great underground lakes. But instead, as its name suggests, it is squeezed into tiny holes in the porous rock with which it was formed, very much like water soaked into a sponge. When this oil-bearing rock--usually sandstone or limestone--is surrounded by layers of hard rock, the oil is trapped and collects in large quantities (see sketch).

So to find the oil, scientists must first find the right kinds of rocks. They start by making surveys of surface formations, giving special attention to sedimentary basins left behind long ago by inland seas. They also look for earthquake faults or fractures that may have sealed in the oil. Complicated instruments give clues as to what kinds of rocks lie below. The seismograph (SIZE-mo-graf), for example, maps underground rock formations by measuring the time it takes for sound waves to bounce back.

But the only way you can tell for sure whether there is oil down there is to drill. And only one out of every fifty wells drilled produces enough oil to make it worth the effort.

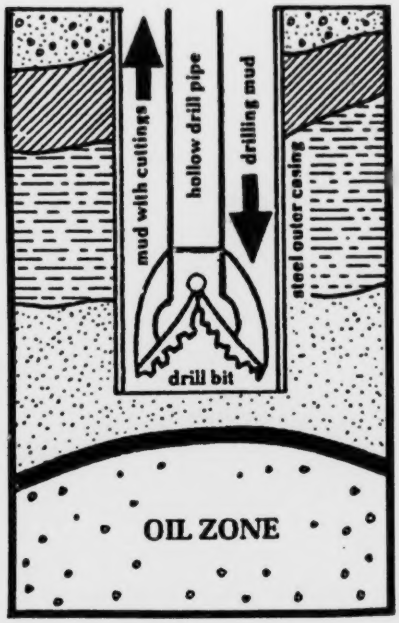


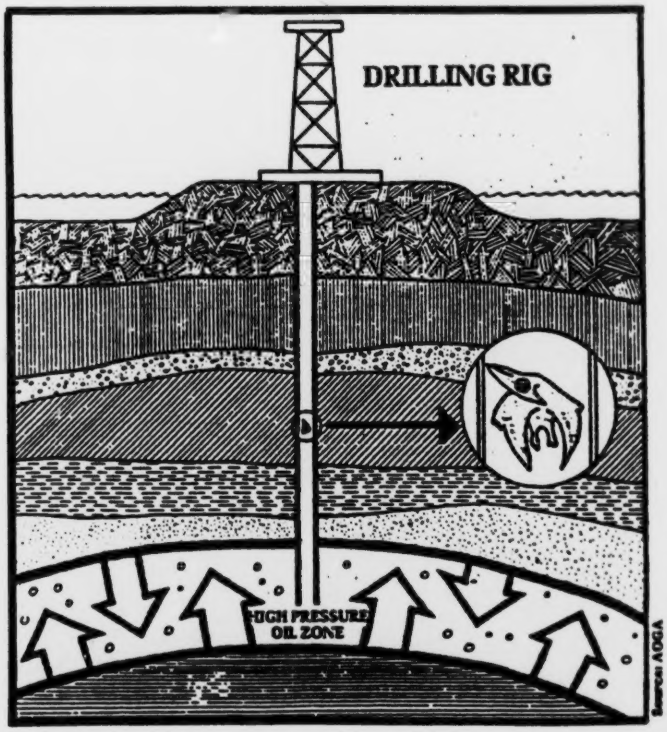
Source: University of Oregon Sea Grant Program

Drilling is done from a tall rig or platform with a heavy-duty system of pulleys and blocks to handle long lengths of pipe that must be added as the hole gets deeper. That wicked-looking rotary drill bit (see sketch) works much like a dentist's drill.

A special kind of drilling mud flows down the hollow pipe to flush away rock cuttings as the drill grinds through the earth. This mud then rises through the outer shell casing to carry the rock chips to the surface, where they are screened out and checked for traces of oil. The mud also serves as the first line of defense against possible blowouts.

When oil is struck, the drill pipe and bit are pulled up and holes are punched in the casing for the oil to flow through. And it is pushed up the pipe by the incredible underground pressures that have been building up since the pterodactyl's time.


mud with cuttings
hollow drill pipe
drilling mud
steel outer casing
drill bit
OIL ZONE


DRILLING RIG
HIGH PRESSURE OIL ZONE
Source: AOGA

4B Where Does the Oil Go?

Directions: Read the following story and answer the questions at the end.

Once the oil comes in, the well is capped and equipment is installed to control the flow, and to separate the crude oil from the natural gas. What happens after that depends on where the well is located.

At Prudhoe Bay, for example, the largest known oil and gas field in North America lies beneath the lonely Arctic coast, which is ice-bound most of the year. So the oil must run a long route to market.

From the wells, the crude oil moves through small pipelines to the big trans-Alaska pipeline. There it begins the 800-mile journey to Valdez, where it is loaded on tankers for shipment Outside. The natural gas that comes up with the oil is run through a gas compressor plant at Prudhoe and then pumped back into the earth for storage, where it awaits construction of the proposed natural gas pipeline, which would carry it either across Canada to the Lower 48, or across Alaska to some ice-free port, from which it would then be shipped Outside via tankers.

On the other hand, the Kenai-Cook Inlet Basin, Alaska's only other producing field, lies close to population centers. Much of its natural gas is piped directly to Anchorage and other nearby communities for use as fuel. And at Nikiski on the Kenai Peninsula, modern plants and refineries process the oil and natural gas into gasoline, jet fuel, heating oil, diesel, liquified gas and fertilizer.

And those are just a few of the products that can be made from petroleum. Petrochemicals (chemicals made from oil and gas) are used as a base for a wide assortment of things, from plastics to vitamins to records, detergents, movie films, fabrics and antifreeze.

This strange stuff we call petroleum is made up almost entirely of only two elements--hydrogen, a gas-like element that will burn; and carbon, a chemical element that is found in all living matter. If you really want to sound like a pro, you can use the scientific word for petroleum, which is "hydrocarbons." These hydrocarbons are present in thousands of different combinations that can be separated and purified in the process called "refining."

The first step in refining is to sort out the major "fractions" or parts of the hydrocarbons that make up crude oil. These fractions boil and vaporize (like steam) at different temperatures. So the simplest form of refining works like this:

a. The crude oil is heated in a furnace and the vapor is piped into a tall refinery tower.

b. Hot steam is pumped in below to speed up the process.

c. The vapors from the different fractions rise, cool off and condense (turn back into liquid) at different levels.

d. There they are drawn off and collected for further processing if necessary--except for the ghost of Pterodactyl, who has finally taken wing again.

The preceding worksheets are excerpted and adapted from Alaska Tidelines (see credit at beginning).

REVIEW:

1. Where does the gas from Prudhoe Bay go? ____________________

____

2. Where does the gas from the Kenai-Cook Inlet Basin go?

____

3. Where does the oil from Prudhoe Bay go? ____________________

____

4. Where does the oil from the Kenai-Cook Inlet Basin go?

____

5. Define petrochemicals. ______________________________________

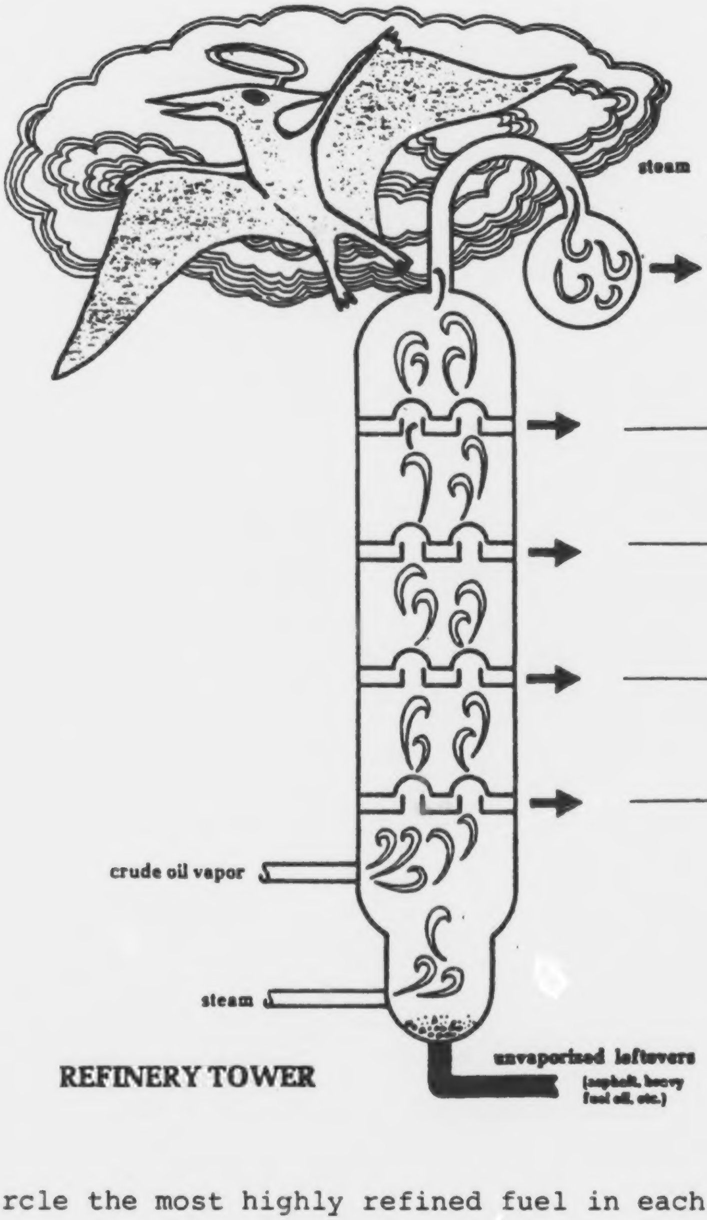
____

6. What are the major elements that make up petroleum?

____

4B

7. Here is a drawing of a refinery tower that shows at which points the different products are drawn off and collected. Fill in the blanks. (Hint: Lubricating oil is drawn off first; then heating oil; then jet fuel; then gasoline; then fuel gas.)


steam
crude oil vapor
steam
unvaporized leftovers
(asphalt, heavy fuel oil, etc.)

REFINERY TOWER

______________(A)

______________(B)

______________(C)

______________(D)

______________(E)

8. Circle the most highly refined fuel in each case:

a. jet fuel or gasoline
b. lubricating oil or asphalt
c. heating oil or jet fuel

The Alaska Oil Timeline

4C

"THE ALASKA OIL TIMELINE" is excerpted and adapted from "Oil Development: THE FIRST HUNDRED YEARS," which appeared in Alaska Tidelines, Volume IV, Number 4, December 1981/January 1982. Virginia Sims, editor. Copyright © 1981, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509, to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice, and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

DIRECTIONS: Make a timeline: draw a straight line on a large sheet of paper. Mark if off in equal segments to represent the first 100 years of Alaska's oil development, leaving room at the right end of the line to write in recent events. Then cut out the following paragraphs and place them in the proper order on your timeline.

Long before the white man came, Alaska's Native people had known about the oil. They found it oozing out of the ground in smelly seeps at widely scattered spots along the North Gulf coast, or gathered in dark gooey ponds on the frozen Arctic slope. Sometimes they burned it in their stone lamps or used it to coat their skinboats. But for the most part they ignored it.

The oil age in Alaska as we know it now began slightly more than 100 years ago. And the story opens with a prospector known only as Edelman.

April 1974 - Construction begins on the North Slope Haul Road--the first road to the Arctic Coast--built to carry supplies to Prudhoe Bay.

1911 - Katalla begins to look like a boom town as the population swells to nearly 200. More shallow wells are dug and Alaska's first refinery goes into operation. (The refinery burned down in 1933 and the wells were capped, after producing a total of 154,000 barrels of oil--about one day's present production from Cook Inlet.)

September 1969 - The first North Slope oil lease auction sale brings the State of Alaska $900 million in oil company bonus money.

1957 - Commercial production comes of age with a major oil strike at Swanson River on the Kenai Peninsula. Operations quickly spread to offshore waters of Upper Cook Inlet as other large oil and natural gas fields are tapped.

November 1981 - The two billionth barrel of Prudhoe Bay oil arrives at Valdez.

1882 - The first oil and gas claim recorded in Alaska is staked at Iniskin Bay on the west side of Cook Inlet by a prospector who signs his name simply "Edelman."

1900 - The first Alaska exploratory well is drilled on the Iniskin Peninsula--not by Edelman (who has taken off for parts unknown), but by a firm called the Alaska Petroleum Company. Oil is struck at 700 feet. But unfortunately the drillers choose to continue, hit water, and have to abandon the effort.

4C

1925-1941 - Action picks up as major oil companies enter the Alaska scene, sinking test wells at a variety of locations in southern Alaska from Killisnoo on Admiralty Island in the Panhandle to Kanatak on the Alaska Peninsula. Exploration ceases with the outbreak of World War II.

1902 - Alaska's first production well is brought in on prospector Thomas White's claim at Katalla, about 50 miles southeast of Cordova. Oil is struck after drilling to only 366 feet, but it is tough going--"drilling" at that time involving pounding away at the ground with a heavy drilling bit suspended from a wooden derrick, and stopping from time to time to let workers bail out the rock chips from the hole.

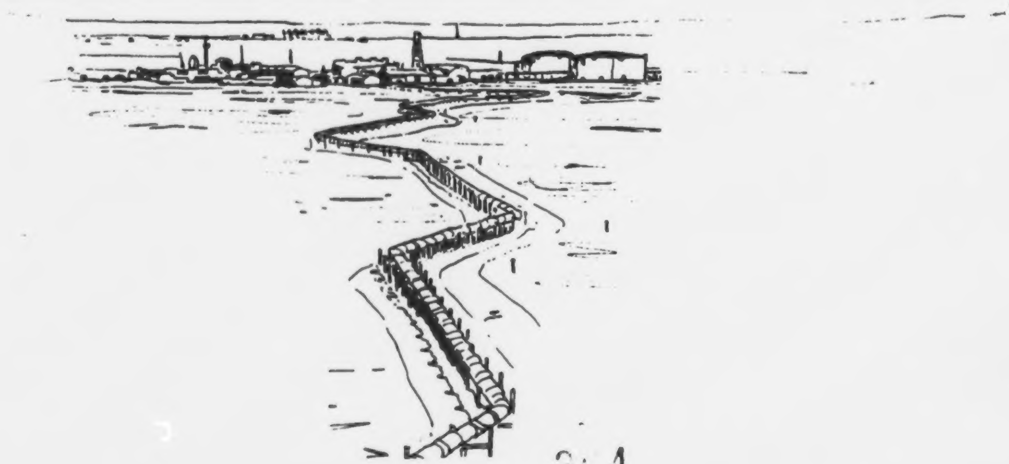
1923 - President Warren G. Harding signs an executive order creating National Petroleum Reserve No. 4, a 37,000-square-mile area of the North Slope (including Mr. Van Valin's lake) set aside to "insure a future supply of oil for the Navy."

July 1977 - First Prudhoe Bay oil arrives at Valdez for tanker shipment Outside.

July 1968 - News of the discovery at Prudhoe Bay of the largest oil and gas field in North America marks a major turning point in Alaska's history. The field is estimated to hold nearly 9.5 billion barrels of recoverable oil and 26.5 trillion cubic feet of natural gas.

1914 - After hearing reports of an "oil lake" near Smith Bay southeast of Barrow, Wainwright school teacher William Van Valin hitches up his reindeer and drives 550 miles to investigate. He finds a lake of what looks like engine oil, 200 by 400 feet in size, and puts up a sign reading "Arctic Rim Mineral Oil Claim." It is the first petroleum claim to be staked on the North Slope.

March 1975 - After many delays, construction begins on the 800-mile-long Trans-Alaska Pipeline from Prudhoe Bay to the ice-free port of Valdez. When finished, it will have cost $7.7 billion.



Alaskan Oil Finance

4D

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WHERE IT COMES FROM...

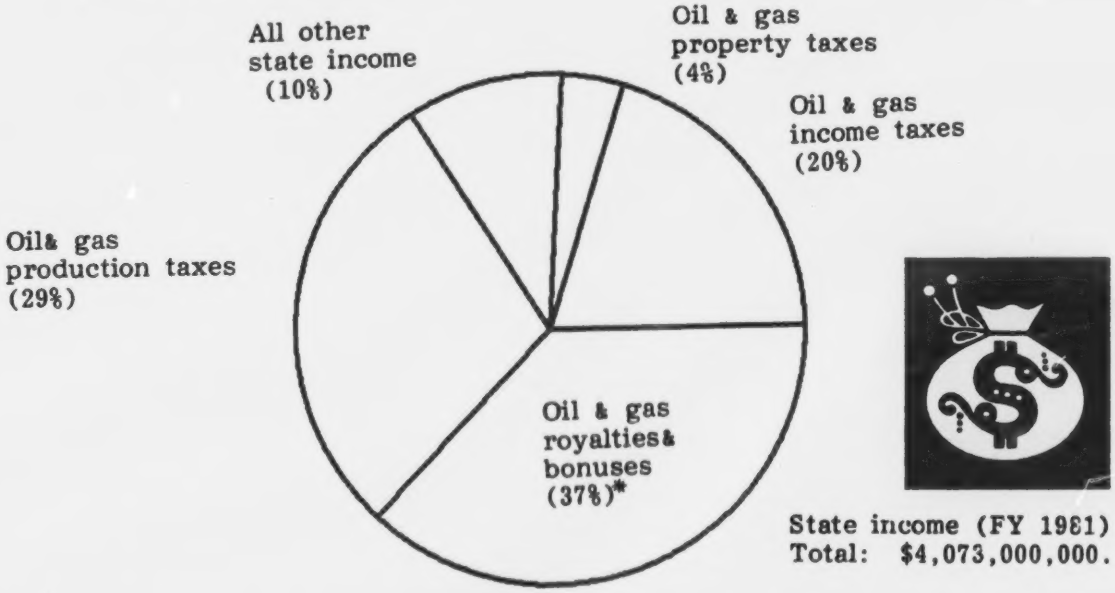
Ready for a little high finance?

1. This pie chart shows where the State of Alaska's money came from during fiscal year 1981. What percentage of the state's income was paid by the oil and gas companies?

   __________percent

2. Total revenue (taxes and other income) received by the state that year was about $4 billion. What did the 10 percent from non-petroleum sources amount to in dollars? $__________

   What was the dollar amount paid by oil and gas industry sources? $____________



State income (FY 1981)
Total: $4,073,000,000.

*"Royalty" is money paid to a landowner for oil taken from his property. A "bonus" is the cash bid paid by oil companies for the exclusive right to lease or rent potential oil lands. About 95 percent of the oil produced in Alaska today comes from state-owned lands.

WHERE IT GOES

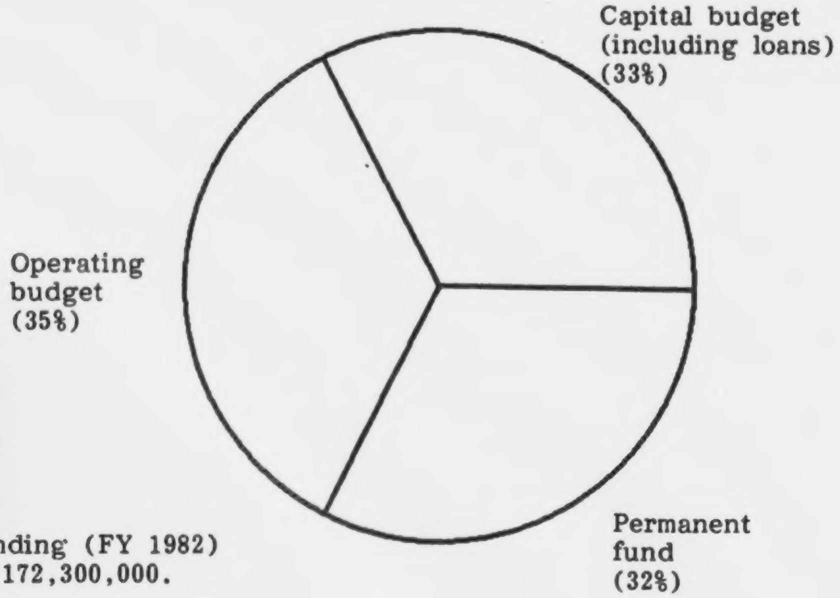
This pie chart shows what the members of the 1981 state legislature decided to do with the money. (Although it looks as if they spent more money than the state took in, this figure includes funds from the federal government not shown on the chart above, plus $918 million left over from the year before.)

As you can see, the money went in almost equal amounts to three general areas:

1. PERMANENT FUND. This fund was set up in 1977 to save some of those billions for that rainy day when the oil income tapers off. The fund totaled about $2 billion in 1982 and was earning about 16 percent of that a year in interest and investments. (If you want to find out how much it made in 1982, multiply $2,000,000,000 x .16 = $_________________.)

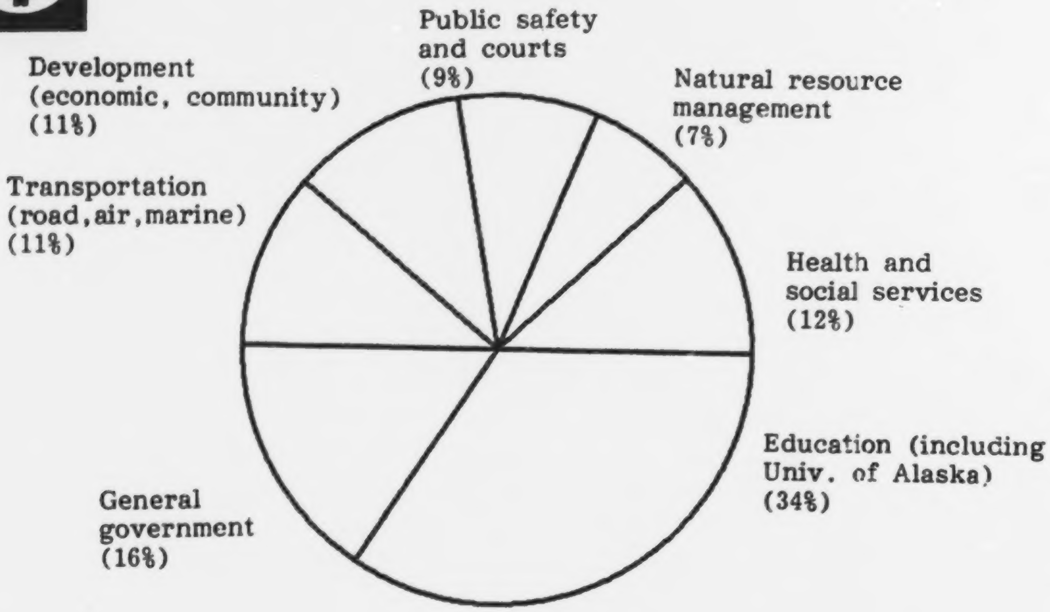
2. CAPITAL BUDGET. "Capital" projects are major things that are built or bought, such as highways, docks, schools, airport improvements, ferries, educational TV equipment and such. The capital budget also provides money for low-cost loans, mostly in housing construction. About 74 percent of this budget (or $1.4 billion) was earmarked in 1982 for capital projects. That left about _____ percent for loans.

3. OPERATING BUDGET. This budget takes care of the ongoing expenses of state government and the operating costs for schools, social services, the court system, etc. It pays the salaries of the Alaska's 15,000-plus full-time state employees.



State spending (FY 1982)
Total: $6,172,300,000.

Operating budget (FY 1982)
Total: $1,964,300,000.



a. The operating budget pie chart shows that the state is spending about half of all its operating funds in just two areas. What are they?

____

b. What general area gets the least amount of money?

____

c. If you were a state legislator, how would you carve up this pie?

____

____

Where would you spend more money?

____

____

Where would you spend less?

____

____

4E

Petro Puzzler

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Starred (*) words are based on information in this activity.

1	2	3	4	▨	5	6	7	8
9				▨	10			
11		▨	12	13		▨	14	
15		16	▨	17		18		
▨	▨	19	20	▨	21		▨	▨
22	23			24	▨	25	26	27
28		▨	29		30	▨	31	
32		33		▨	34	35		
36				▨	37			

ACROSS

- *1. The word "petroleum" in Latin means _____ oil.
- *5. Alaska is believed to have about _____ of the nation's remaining undiscovered oil reserves.
- *9. Turning pterodactyls (and such) _____ oil took millions and millions of years.
- *10. Oil companies paid about $3.6 billion in state taxes during the 1982 fiscal _____ ending July 1.
- 11. Southcentral (abbr.).
- 12. Christmas colors: _____ & green.
- 14. Northeast (abbr.).
- 15. Kenneth's friends call him _____.
- *17. Unprocessed oil is called _____ oil.
- 19. Letters of the alphabet between D and G.
- 21. Oil seep (init.)
- *22. The first oil and gas _____ in Alaska was staked by a prospector named Edelman.
- *25. The kind of 2-year technological degree offered by a number of Alaska community colleges is called _____ (init.).

DOWN

- *1. One of the prices we pay for oil development in Alaska is the _____ of damage to our wildlife and environment.
- *2. The process of making oil has never been duplicated, so _____ it's gone, it's gone forever.
- 3. Cent (abbr.).
- 4. Republic of Korea (init.) (backwards).
- *5. The chemical word for petroleum is _____ carbons.
- 6. Atomic energy (init.)
- *7. About 95 percent of the oil produced in Alaska today comes from state-owned _____.
- *8. The Trans-Alaska pipeline runs from Prudhoe Bay to the ice-_____ Port of Valdez.
- 13. East Chugach (init.)
- 16. National Education Association (init.).
- *18. Alaska supplies the _____ (init.) with about 18 percent of the oil it uses each day.

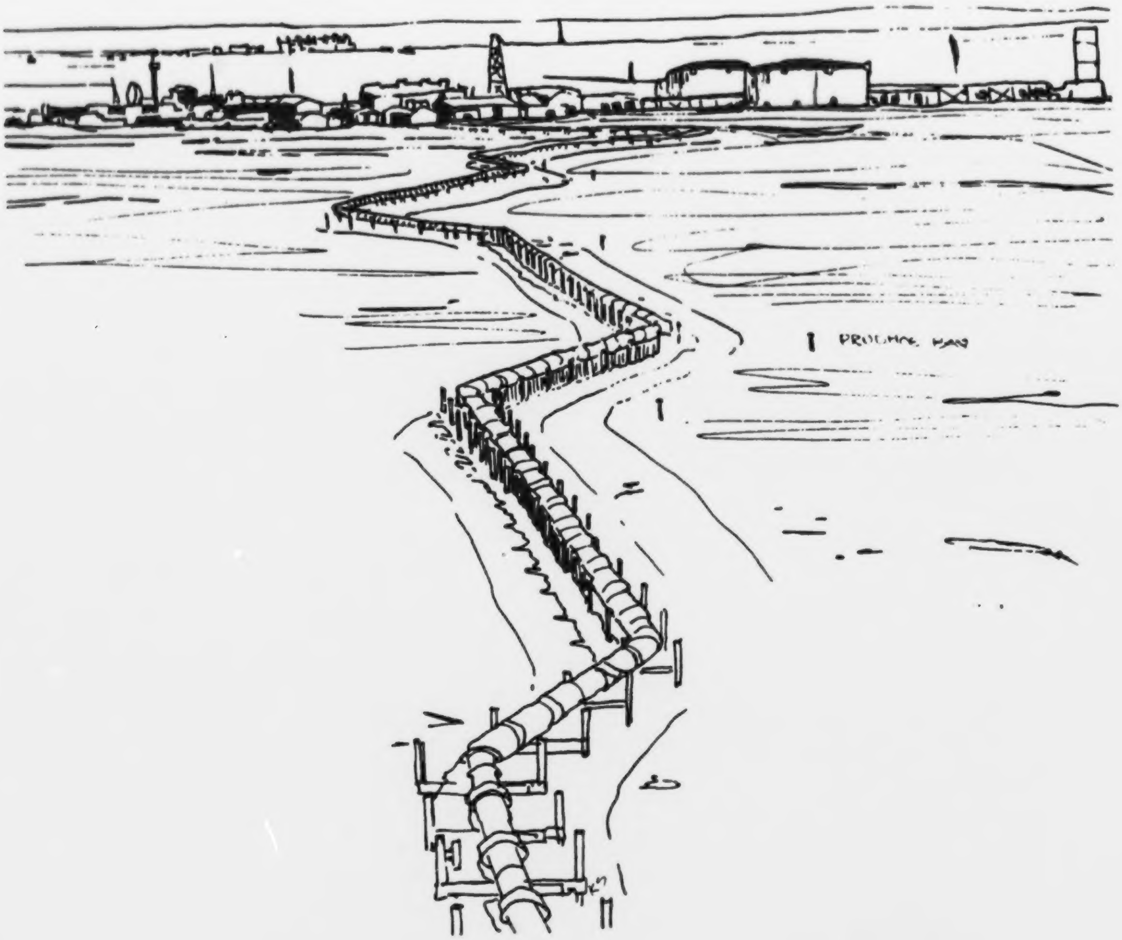
4E

ACROSS

28. Alaska Airlines (init.)
*29. You need a very tall drilling _____ to sink an oil well.
31. Equal Employment (init.)
32. A good Christmas present is cross-country _____.
*34. National Petroleum Reserve No. 4 (PET-4) was created in 1923 when President Harding set aside a 37,000-square-mile _____ of the North Slope.
*36. Oil is formed in mysterious ways under great pressure, _____ and dampness from the decaying remains of plant and animal life...
*37. ...squeezed down between layers of silt, _____ and clay.

DOWN

*20. Alaska's _____ refinery was built at Katalla in 1911.
*22. A "bonus" is a _____ payment by oil companies for the right to lease potential oil tracts.
*23. You may find an "oil _____" on the surface (like Mr. Van Valin did), but underground it is sealed in porous (1 across).
24. Third note of the musical scale.
26. See, saw, _____.
*27. Bacteria helps in the formation of oil by breaking down _____ material.
*30. Along with the oil, Prudhoe Bay fields are believed to contain 26.5 trillion cubic feet of natural _____.
33. Iowa (abbr.).
35. Regular Army (init.).



4F

Ocean Oil Pollution

Adapted from OIL SPILL! by Rosanne Fortner and Stephanie Ihle, Ohio Sea Grant Program, Ohio State University, 1980. Used by Permission.

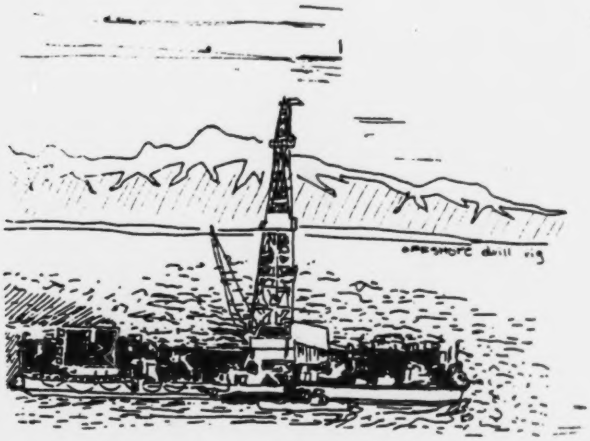
What are the sources of ocean oil pollution? Here's a chart that tells what the sources were in 1975. They haven't changed much since then.

Source of Petroleum	Column 1 metric tons (mta)	Column 2 % of total	Column 3 Size of Wedge
Natural seepage*	0.60	10	36°
Tanker operations	1.33	22	______
Tanker accidents	0.20	3	______
Other transportation activities	0.60	10	______
Runoff from rivers and cities	1.90	31	______
Coastal facilities	0.80	13	______
Offshore drilling	0.80	1	______
Atmospheric fallout	0.60	10	______
Total	6.11	100%	Total Degrees 360°

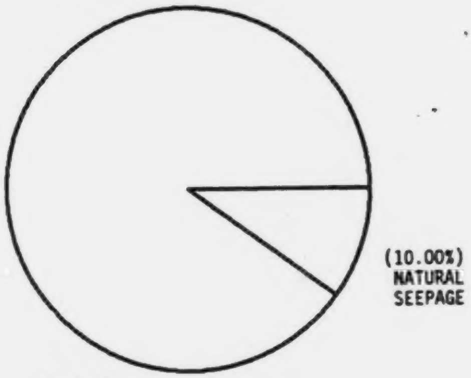
*Leaks from oil deposits.

(Data from U.S. National Academy of Sciences, Petroleum in the Marine Environment. Washington, D.C., 1975.)

Now, fill in column 3 above and use your protractor to complete the pie graph below. Find wedge sizes for column 3 by multiplying the percentage (column 2) by 360 (the number of degrees in a circle). For example: 0.10 (the same as 10%) x 360° = 36°. After you've filled in the column, add the numbers to see whether they total 360°. If so, measure the angles with your protractor, then mark wedges and label your "pie."



SOURCES OF PETROLEUM GOING INTO THE OCEANS



1. a. Most of the oil spills we hear about involve which one of the sources on the chart?

   ____

   b. What percentage of ocean oil pollution is caused by that source? ______________

2. a. Which source describes oil spills in harbors?

   ____

   b. What percentage is caused by that source? __________

3. When an oil tanker (ship) is carrying no oil, it fills up its cargo space with water so that the ship will be stable. A ship getting ready to load new cargo will dump the water it has been using as ballast. This ballast will have picked up oil from the hold, and the oily wastes are flushed out into the harbor.

   a. Which source describes this type of pollution?

   ____

   b. What percentage is caused by that source? __________

4. How could oil get into the water from offshore drilling operations?

   ____

   ____

5. a. List some ways that petroleum could get into rivers.

   ____

   ____

   b. The next time you are riding on a highway, look at the road ahead of you. A well-traveled highway usually has a dark streak running down the center of each lane. The streak is caused by petroleum products, such as crankcase oil, that drip out of vehicles. How could this serve as a source of oil pollution for water?

   ____

   ____

6. a. Which of these ocean oil pollution percentages do you think will increase in the future? ______________

   b. Which do you think will decrease? ______________

4G

Oil Spills and Clean-ups

Oil on beaches damages shoreline life. Oil seeps downward into sand and remains there for years. Rocky shorelines can clean themselves naturally through wave action, but bays, estuaries and marshes have few waves. Oil spills in such areas are very damaging.

Oil causes serious harm to birds by coating their feathers. An oily bird does not float, and it has no insulation against temperature changes. Also, birds poison themselves by eating the oil that coats them.

Oil is sometimes responsible for smothering communities of animals that live on the sea floor. This is especially important to the shellfish industry. Most of these areas will eventually become settled again, but some organisms, like mussels, cannot survive in an oiled area.

Adult fish are not affected by oil pollution as much as other organisms. A massive spill can kill large numbers of fish, but, ordinarily, adult fish are able to escape injury from minor accidents. Smolt and eggs are extremely vulnerable to oil spills, however.

Different petroleum products have different effects on organisms. Diesel or heating oils are the most poisonous, while heavy crude and fuel oils are the worst for smothering animals.

Now, answer these questions:

1. Describe a kind of oil spill that could kill large numbers of adult fish, smolt, or eggs.

   ____

   ____

2. What kinds of petroleum products have the most undesirable effects?

   ____

3. How do these affect the organisms? ____________________

   ____

4. Are all areas of the coastline affected in the same way by oil pollution? ____________ If not, explain these differences.

   ____

   ____

   ____

Success in cleaning up an oil spill depends upon preparedness and rapid action by the spiller and by federal, state and local agencies. When a spill occurs, it is reported to the nearest U.S. Coast Guard station. If the spiller does not clean up the pollution, the Coast Guard takes over and the spiller pays the clean-up costs.

If an oil spill is contained in one area, cleanup is easier and less environmental damage is likely to occur. Containment must be done as soon as a spill is detected if it is to be effective.

5. Now get out your container of water. Assume that an oil tanker springs a leak in the middle of your "ocean." Drop a few drops of oil in your pan or bowl of water.

   Try to contain the oil. Tie the ends of a piece of string together and gently place the circle of string on top of the water with the oil inside. Slowly add two more drops of oil inside the circle as your "tanker" continues to leak. Does the string keep the oil from spreading over the entire ocean? __________ This is how a "boom" operates to contain a spill.

6. Some contained oil can be reclaimed (collected for further use). Use a dropper to try to reclaim some of your oil. About how much oil were you able to reclaim?

   ____

7. Ordinarily, oil floats on water because it is not as dense as water. Increasing the oil's density will make it sink to the bottom. Sprinkle enough sand on the oil spill to cause it to sink.

   a. Does this method removal all (or most) of the oil from the surface?

      ____

   b. When this method is used, what effects will it have on the ocean environment?

      ____

      ____

      ____

c. Is sinking a good way to clean up an oil spill? ______________________________

Explain. ______________________________

____

8. Now try to mop up the spill with a paper towel. How well does that work?

____

9. Household detergents are used to remove oil from laundry or grease from dishes. Add detergent to your "ocean." How do detergents help to clean up an oil spill? ______________

____

Unfortunately, many detergents cause more damage than the oil spill itself!

10. Now try some commercial oil-absorbent material. How well does that work?

____

Unfortunately, it is very expensive when you consider the size of most oil spills.

11. Add another drop of oil to your "ocean." Then put some seaweed or pondweed in the oil spill.

a. What happens? ______________________________

____

b. How would this affect the ability of plants to produce food?

____

____

12. Add a bird feather to the oil spill.

a. What happens? ______________________________

____

b. What would happen to a bird that swam into an oil spill?

____

____

13. What difficulties might you have in trying to clean up oil spills in Alaskan waters? ______________________________

____

____

Simulate some of these conditions and record your results.

____

____

14. Now clean up your "ocean" and decide on a proper place to dispose of your oil messes!

Adapted with the help of Jennifer Allison Keim of the Scammon Bay School from Oil Spill! by Rosanne W. Fortner and Stephanie Ihle, Ohio State University, Ohio Sea Grant Program, 1980. Used by permission.

4H Above and Below the Sea Floor

"ABOVE AND BELOW THE SEA FLOOR" is excerpted and adapted from Alaska Tidelines, Volume IV, Number 5, February 1982. Virginia Sims, editor. Copyright © 1982, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission for has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509, to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice, and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

Alaska's landmass doesn't end with its coastline. It slopes gently out beneath the seas, forming a vast underwater plateau called the continental shelf (shown in cross-hatching). The marine life above and the mineral wealth within this shelf make it one of the richest resource areas in the world.

Waters and submerged lands outside the state's three-mile limit are controlled by the federal government, which in 1981 announced a plan to greatly speed up offshore oil lease sales. Over a five-year period, from 1982 to 1987, 17 sales would be held throughout the Alaska outer continental shelf. This map shows the "planning areas" for the sales. The amount of oil listed for each area is an estimate of undiscovered recoverable resources, which are resources that can be extracted economically with existing technology. The estimates take into account the economic risk that an area may be found to have no commercial quantities of oil. (Figures are from the Arctic Summary Report, Jan. 1983, the Bering Sea Summary Report, Sept. 1983, and the Gulf of Alaska Summary Report Update, May 1984, published by the Minerals Management Service of the U.S. Dept. of the Interior.) (There is no way, of course, for this map to cover the fisheries and marine mammals in this area--except for a few.)

While the federal government has the last word on when, where and whether the lease sales will be held, the program is submitted to the state for comment and review. You be the reviewer:

1. According to these figures, which area holds the most oil?

   ____

2. How many planning areas do the bowhead whales pass through on their annual migrations?

   ____

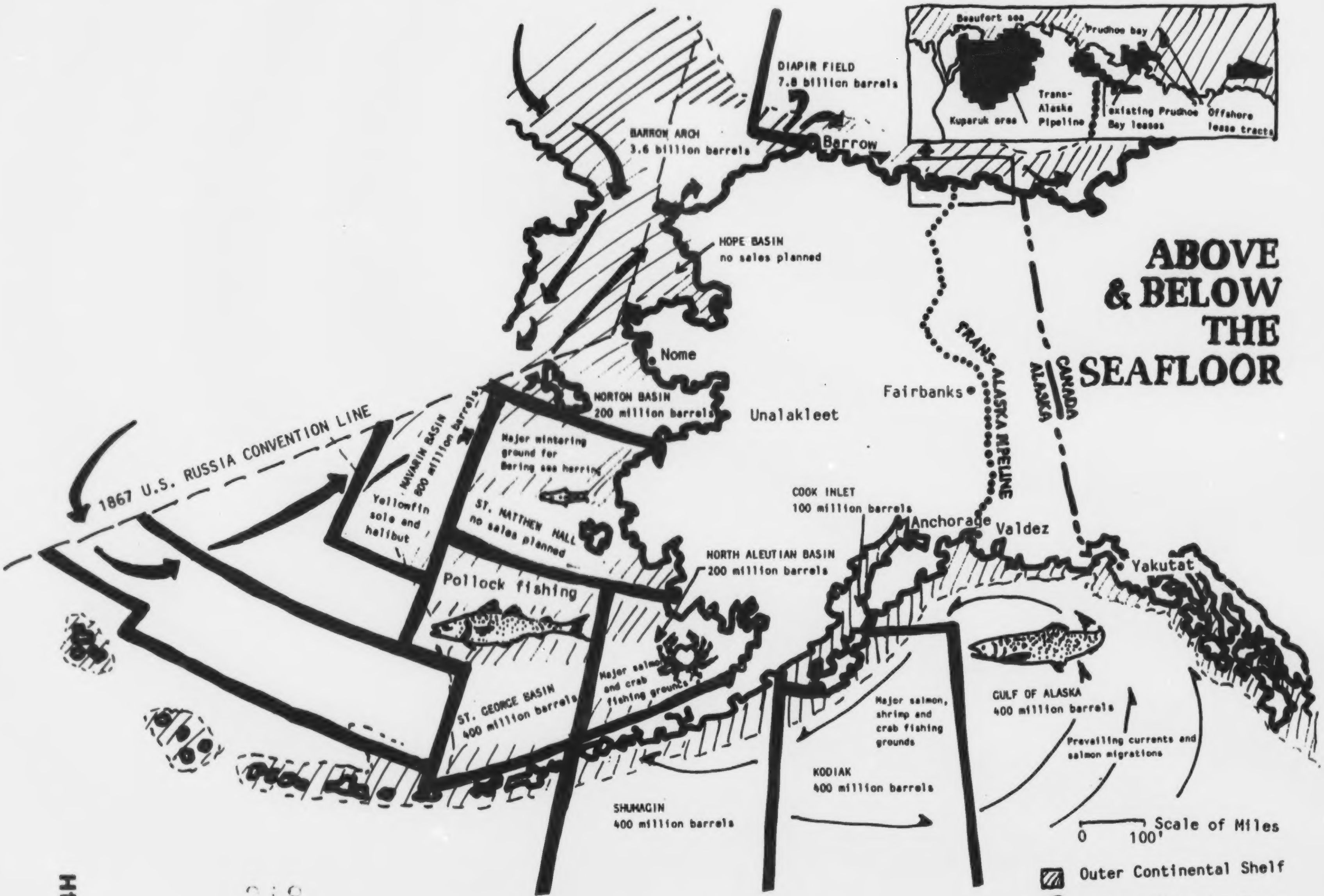
3. The Trans-Alaska Pipeline carries about 1.5 million barrels of oil at day from the Prudhoe Bay to Valdez. At that rate, how long would it take a pipeline of that size (48 inches in diameter) to carry all the (estimated) oil from the Norton Basin?

____

4. Which is closer to Unalakleet (using the scale of miles)--the edge of the Outer Continental Shelf or the Alaska-Canada border?

____

ABOVE & BELOW THE SEAFLOOR


DIAPIR FIELD
7.8 billion barrels
Beaufort sea
Prudhoe bay
Kuparuk area
Trans-
Alaska
Pipeline
existing Prudhoe
Bay leases
Offshore
lease tracts
BARROW ARCH
3.6 billion barrels
Barrow
HOPE BASIN
no sales planned
Nome
NORTON BASIN
200 million barrels
Unalakleet
Fairbanks
TRANS ALASKA PIPELINE
CANADA
ALASKA
1867 U.S. RUSSIA CONVENTION LINE
NAVARIN BASIN
800 million barrels
Major wintering
ground for
Bering sea herring
Yellowfin
sole and
halibut
ST. MATTHEW HALL
no sales planned
COOK INLET
100 million barrels
Anchorage
Valdez
NORTH ALEUTIAN BASIN
200 million barrels
Yakutat
Pollock fishing
Major salmon
and crab
fishing grounds
ST. GEORGE BASIN
400 million barrels
Major salmon,
shrimp and
crab fishing
grounds
GULF OF ALASKA
400 million barrels
Prevailing currents and
salmon migrations
KODIAK
400 million barrels
SHUMAGIN
400 million barrels
0
100'
Scale of Miles
Outer Continental Shelf
Bowhead Migration Route

Oil in Troubled Waters

A Tidelines TV News Special

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(Note: Before this article appeared in February of 1982, it was circulated to representatives of fishing, oil and gas, environmental and Native groups for critical review as to content and balance. Some changes have been made in the original text in an effort to present all sides as fairly as possible.)

Winds of change are blowing over Alaska. When the largest oil field in North America was discovered at Prudhoe Bay in the late 1960s, few doubted that the state would ever be quite the same again.

This is an imaginary TV News Special about the problems and promises of future oil development. The people in it are imaginary, too. But their questions and concerns are very real. And they have been discussed in such widely scattered places as an oil company board room, the wheelhouse of a fishing boat, and the community hall of an isolated village on the shores of the Bering Sea.

Read the script through. Then choose members of your class for each part and let them select a team of "advisers." Each part represents a different point of view, and there are other arguments you might think of as you go along.

Cast of Characters:

MODERATOR
CARRIE, spokesperson for the U.S. Interior Department
MIKE, oil and gas company official
JIM, member, Alaska chapter, Friends of the Environment
OLAF, commercial fisherman
JOE, North Slope Borough official
BARB, member of the governor's staff
JACOB, Mayor of a village on the Bering Sea coast
FAY, marine biologist

MODERATOR: Good evening, ladies and gentlemen.

Prudhoe Bay seems far away to most Alaskans. Still, the oil income from that great discovery has touched people in all parts of the state. It has meant less taxes, more jobs, better airports, low-cost loans, satellite TV, new village schools with basketball courts and hot showers, and a lot of other things we didn't think we'd get for awhile.

Oil development always has its risks, especially where unspoiled seas and coasts and wilderness areas are concerned. But so far the damage has been limited to an occasional spill along the Trans-Alaska pipeline to Valdez.

Then last spring the U.S. Interior Department announced a plan for oil development that would bring the risks of Prudhoe Bay to more than two-thirds of Alaska's coastline. In a move to make the nation less dependent on foreign oil, the government said it would speed up lease sales on hundreds of millions of acres of offshore lands in the Bering, Chukchi and Beaufort seas. Most of these waters not only have been called the most dangerous in the world, but they also hold some of the richest fisheries in the world.

That announcement touched off a storm of protest--from fishermen, from environmentalists, and from the people who live along those isolated coasts. Is it possible to drill safely in such treacherous waters? Can you clean up a spill in 40-foot seas? Are we moving too far too fast?

Our panel here tonight is made up of people who will try to answer some of those questions, and may raise some more of their own. Let's start with you, Carrie. Tell us about this new plan. And why the big rush to drill offshore?

CARRIE: The President feels very strongly that we need to find out as soon as possible how much oil the United States has within its borders. We think more than half of the nation's undiscovered oil may lie in Alaska and its outer continental shelf. But we won't know for sure until we look. So we want to give the oil and gas people a chance to discover what's out there and where it is.

MODERATOR: How much offshore land are we talking about?

CARRIE: Some changes still are being made. But our original plan is to offer about 200 million acres for leasing each year for the next five years. All that land certainly won't be leased. But the oil companies will be able to develop the most promising tracts.

JIM: One billion acres in five years is far too much. That adds up to an area about the size of the whole land mass of Alaska. You even took the oil companies by surprise. Some of them said it might be more than their experts and equipment could handle.

MIKE: Oh, no. We can handle it. We're ready. We've more than doubled our offshore surveying over the past two years. We wouldn't be out there if we didn't know what we were doing.

CARRIE: You see, Jim, most of these areas were already set for future leasing. We just increased the number of sales, changed some of the dates, and rearranged a few boundaries so that they line up better with the best potential oil basins.

OLAF: You sure did a job on some of those boundaries. You enlarged the North Aleutian Basin to take in Bristol Bay, which has the biggest red salmon runs in the world. Think of the damage a spill out there might do! And that's not all. During the height of the season we hardly have room for our own fishing fleet--and think of the foul-up of boats and nets and drilling rigs and seismograph tows...

MIKE: (interrupting) We would hold up exploration during the peak of the runs.

OLAF: Well, how about St. George Basin? There are year-round fisheries out there--for pollock, cod, yellowfin sole. Millions of tons of whitefish are harvested each year in that area by foreign fishing fleets. It's a major source of food fish for the world. And it's also one of the state's prime crab-fishing grounds.

The point is that fish are renewable resources. Oil isn't. These fisheries can last for thousands of years if we don't goof. But the life of an oil field is only 20 to a top of 50 years.

BARB: The governor went through the roof when he heard that Bristol Bay was included. And he didn't like the idea of leasing in St. George Basin much better. But at his request, Interior Secretary Watt said he might change or delay some of the sales in those two areas.

CARRIE: Interior Secretary Watt is a reasonable man. He's aware of Alaska's concerns. He will listen to facts presented to him about possible risks. But because of the nation's pressing need for oil, he won't listen to fears unsupported by facts or experience.

OLAF: But we fishermen are about the only ones who have had experience in the southeast Bering Sea. And we know how wild those waters can be. Winds to 130 miles an hour. Snow, sleet, rain, fog. It isn't called the worst weather in the world for nothing.

JACOB: We know, too. We hunt on the moving ice pack farther north. And we have been caught in snowstorms where you cannot see ten feet, with winds so strong you have to get down and crawl to move. How would you clean up an oil spill in weather like that?

JIM: The government itself has made some pretty frightening forecasts for oil development in the Bering, Chukchi and Beaufort seas. It says right here in its own Environmental Impact Statement that we can expect 30 oil spills of more than one thousand barrels and 10 oil spills of more than ten thousand barrels during the probable life of these basins.

CARRIE: Those reports have to consider the whole range of possibilities--from no spills at all to the worst that can be expected. And, of course, everybody seems to leap on the worst possibilities.

JIM: Well, my understanding was that those figures were "best guesses."

MIKE: Actually, Jim, we have a very clean record offshore. Let me give you a few figures. In the past ten years there have only been two spills of more than 1,000 barrels from all of the offshore rigs operating in U.S. waters. Probably the worst spill we've ever had was in 1969 off Santa Barbara, California. And even that did no lasting damage. The fish were still there--although the fishermen didn't want to put their nets down through the oil. And the shellfish re-established themselves within a year or two.

JACOB: The idea of trying to fish in oily waters is sickening. Who would want the fish? Our only cash income comes from commercial fishing. How could we make any money? We could not go to the bank. The Bering Sea is our bank. Furthermore, anything that affects the food chain of the sea would do far more damage here, because the growth rate of marine life is far slower in cold water.

MIKE: I was talking about the worst case, Jacob. We've learned a lot since then. And we've found that in the long run, oil development has had very little effect on the fisheries.

BARB: The governor says he'd sleep better at night if he heard that from a marine biologist instead of a petroleum engineer.

MODERATOR: Well, let's hear from our marine biologist. What do scientists think, Fay?

FAY: Frankly, scientists disagree on the effects of oil on fish and shellfish. Some say that fish like salmon wouldn't be affected because they could swim away from a spill. Others think the oil might disrupt their migrations--even plugging up their nostrils and throwing off their homing instincts.

Deepwater bottom-dwellers such as crab probably wouldn't be directly affected because in very cold water the oil usually stays on the surface. But an oil spill certainly could kill young crabs and other free-swimming larvae. And if storms or breaking waves churn the oil into bottom sediments, intertidal life could be smothered.

We do know that oil is disastrous to seabirds. It gets into their systems when they preen their feathers, and it destroys their insulation so that they freeze or drown. Marine mammals that depend on their fur for insulation, such as fur seals, sea otters and polar bears, also would suffer. We need to know much more about this. But unfortunately, federal funds for such studies are being cut back severely.

MIKE: Believe me, we don't want any oil spills either. And we haven't had any to speak of up here. We've developed new drilling techniques for the Beaufort Sea. And as Joe knows, that's a hazardous environment. We've been operating safely in the upper Cook Inlet for more than 20 years. Cook Inlet has a silty bottom, much like the Bering and Chukchi seas. And there we've learned to deal with some of the biggest tides in the world and chunks of ice churning around all winter.

FAY: But what if you did get a spill, Mike. How could you clean it up?

MIKE: It would be tough and tricky. No question about that. But we've done a lot of research on Beaufort Sea conditions, and we've learned from our Canadian neighbors who have drilled in broken ice farther offshore than we have.

Actually, we've found that our cold climate is a help, so far as cleaning up oil is concerned. Oil in very cold water will thicken and stay on the surface where it can be skimmed up or soaked up. Cold water also keeps it from spreading. For example, a spill of as much as 40,000 barrels in calm cold would cover less than a mile up here, where the same spill in warmer waters might cover up to 100 miles.

JOE: What if the oil is trapped beneath the ice, or is caught in the moving ice as Jacob was talking about?

MIKE: That's a bigger problem. But floating ice sometimes acts as a natural barrier to contain the oil until we get to it...

JOE: ...if you can get to it...

JACOB: ...if you could find it. You would probably find it washed up on our beaches after break-up.

OLAF: How about trying to clean up a spill in 40-foot seas with waves breaking all over the place?

MIKE: Well, no, we wouldn't even try it. But that's where nature takes over for us. In stormy seas, the oil breaks up and evaporates very rapidly. The open ocean has a great ability to absorb oil.

OLAF: Listen, Mike, we don't want to sound totally negative because we all need the gas and oil. We need it for our fishing boats, our snowmachines, our trucks, our planes. We just wish you'd get it somewhere else. And what I would like to know is this: Can anything be done to stop these offshore sales?

CARRIE: Well, the plan still must be approved by the President and passed upon by the Congress.

JOE: But the President is the one who asked for it in the first place, and he certainly seems to be able to get what he wants from Congress.

CARRIE: Well, it's federal land. All offshore land outside the state's three-mile limit belongs to the federal government. And so does the oil from those lands. You've got to realize that that oil doesn't belong to Alaskans any more than it belongs to somebody in Nebraska.

BARB: And unlike the Prudhoe Bay oil, the state won't get a penny for it--except possibly in a few cases where the oil fields might extend out under state lands.

MIKE: Now wait a minute, Barb. This state has been running on oil dollars ever since Prudhoe Bay began producing. We've spent hundreds of millions of dollars to find the oil and you take all the profits.

OLAF: Not all the profits. The oil companies are still making plenty of money.

MIKE: But the state has raised our taxes to the point where we can hardly afford to operate up here. So you shouldn't be surprised that we're willing to move offshore.

JACOB: Still it seems strange. Our lives depend on the fish and animals that live in those waters. You could not find a place to drill that could do us more harm. Yet because it is federal land, we have nothing to say about what you do out there. And we will get nothing for it.

MIKE: Well, talk to Joe here. The North Slope Borough has certainly benefited from the jobs and dollars oil development has brought in.

JOE: Fortunately, Prudhoe Bay is far away from most of our villages. So we are able to benefit without the bad direct effects of a boom-town. Some of our people hold jobs at Prudhoe. But their tours of duty allow for time off so that they can go home to hunt and fish. And some of our villages have invested in the construction of drilling rigs.

FAY: That's odd, since you've been fighting oil development because of its possible effects on the bowhead whale.

JOE: The oil industry is there. That is a fact of life. So to survive, we must make trade-offs.

We're an organized borough, of course, so we can tax oil and gas facilities on lands within our borders. And what we have done is to use this tax money to hire our own people to build new homes, public buildings, light plants and other things that we need--not just in Barrow but in all of our villages.

JACOB: But we don't have any regional government. Our villages are on their own. What will we do when the oil companies move in? What will happen to our lifestyle and our culture? Will it be like Unalaska after the fishing industry moved in at Dutch Harbor? Unalaska isn't an Aleut village any more. It is just a village with some Aleuts living in it.

MIKE: No, no. It doesn't have to be like that. You and your village can decide whether you want to be involved. And if you don't, we'll go somewhere else.

For example, Yakutat chose not to get involved when we were exploring for oil off the North Gulf Coast. So our drilling crews just flew in and out of the airport and never even went into town. On the other hand, Kenai chose to participate, and our plants and refineries there have 90 percent local hire.

And it isn't just the jobs. If we plan together, some of the oil company's needs might be helpful to you in the future. Like enlarging the airport or the boat harbor, or improving your roads and water systems. Maybe even building our warehouse with slanted floors so that you can use it later as a fish processing plant. You might think of these things, too, when you talk about "quality of life."

JACOB: Well, we heard about a recent poll in Barrow that made us wonder. The people were asked about changes that had occurred since oil development began. And even though Prudhoe Bay is more than 200 miles away, they said there was more fighting, drinking and drug abuse in Barrow than there used to be, and not as much helping and sharing. They said prices had risen sharply and fish and game stocks had declined. They still rated the quality of life as "good," but not as good as it was in 1970.

So we worry about what it would be like in our villages. We are so small and the oil companies are so big. And the travelling salesman has been here before.

MIKE: We are not travelling salesmen. Alaska is our home, too, and we are going to be here for many years. We can work together. It isn't oil versus fisheries, or oil versus lifestyles or oil versus anything else. It's oil and fish and whales and seals and people...

BARB: Sometimes it seems as though the outside world is asking the impossible of Alaska. They want us to provide the oil for their industrial economy. They want our prime fish products from unpolluted waters. And they still want us to remain the great unspoiled wilderness area of their dreams.

FAY: Well, we've lived through all kinds of "rushes" before--for gold, for furs, for fish...

CARRIE: And there will be more in the future--for coal, for minerals...

JIM: Which means we've got to handle this one better than it's ever been handled before.

JOE: And we can do it if we're careful--if we don't cut any corners.

JACOB: The oil has been there for millions of years. It will last a little longer.

OLAF: Which brings us back to the first question: What's the big hurry?

The story of development of Alaska's offshore oil resources is just beginning. Find out what has happened since this imaginary debate took place in 1982, and watch for TV and newspaper reports on the current situation.

The preceding article is excerpted from Alaska Tidelines (see credit at beginning).

4J

Riches and Risks

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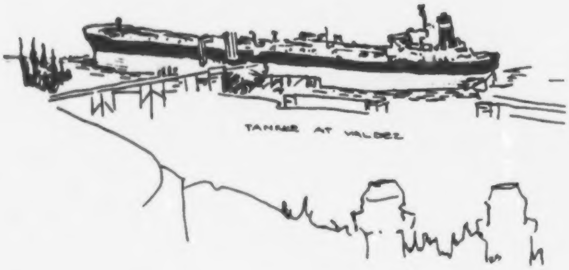
Starred (*) words are based on information in this activity.

1	2	3	4	▨	5	6	7	8
9				▨	10			
11		▨	12	13		▨	14	
15		16	▨	17		18		
▨	▨	19	20	▨	21		▨	▨
22	23			24	▨	25	26	27
28		▨	29		30	▨	31	
32		33		▨	34	35		
36				▨	37			



ACROSS

*1. One of the big problems facing Alaskans today is how to safely produce both oil and _____.
*5. Especially since the U.S. plans to speed up oil lease sales in the Bering, Chukchi and Beaufort _____.
*9. About 200 million _____ (singular) will be offered each year for the next five years.
*10. Most Prudhoe Bay oil is shipped Outside from the _____ of Valdez.
*11. The _____ (init.) Bering Sea is a major source of food (1 across) for the world.
12. In baseball, "runs batted in" (abbr.).
14. Each (abbr.).
15. In football, "touchdowns" (abbr.).
*17. We still have much to learn about how to _____ up oil spills in stormy, ice-filled waters.
19. Cent (abbr.).
21. Sixth note of the musical scale.

DOWN

*1. Some Alaskans feel that offshore oil exploration might be moving too far too _____.
*2. Oil is tougher to clean up in broken ice than it is when the waters are _____ over.
3. Sag River (init.).
4. Him or _____.
*5. With oil maybe a good motto might be: "Drill it, but don't _____ it."
6. Equal Opportunity (init.).
*7. The government plans to offer for oil leasing an _____ about the size of the whole land mass of Alaska.
8. Stanley's friends call him _____.
13. British Columbia (init.).
*16. Outer Continental Shelf (init.) (backwards).
*18. Fork-tailed storm petrels will _____ almost anything they find floating in the open ocean.

ACROSS

*22. The federal government controls off _____ lands beyond the state's three-mile limit.

*25. It is possible that oil production in (5 across) could result in _____ spills of over _____ thousand barrels during the life of the field.

28. You + I = _____

29. Way back when, or long, long _____.

*31. The Beaufort and Chukchi seas are part of the _____ Ocean (init.).

32. The metal that steel is made from.

*34. Oil spreads faster in cold water than it does in _____ water.

*36. Scientists are trying to develop a less fussy strain of "oil bugs" that will clean up the whole _____.

*37. Oil can be transported from offshore production platforms by tanker or pipe _____.

DOWN

*20. The _____-Alaska pipeline now carries about 1.5 million barrels of oil a day.

*22. Pelagic fish like salmon may be able to _____ away from oil spills.

23. _____ and there.

24. Eastern Gulf (init.).

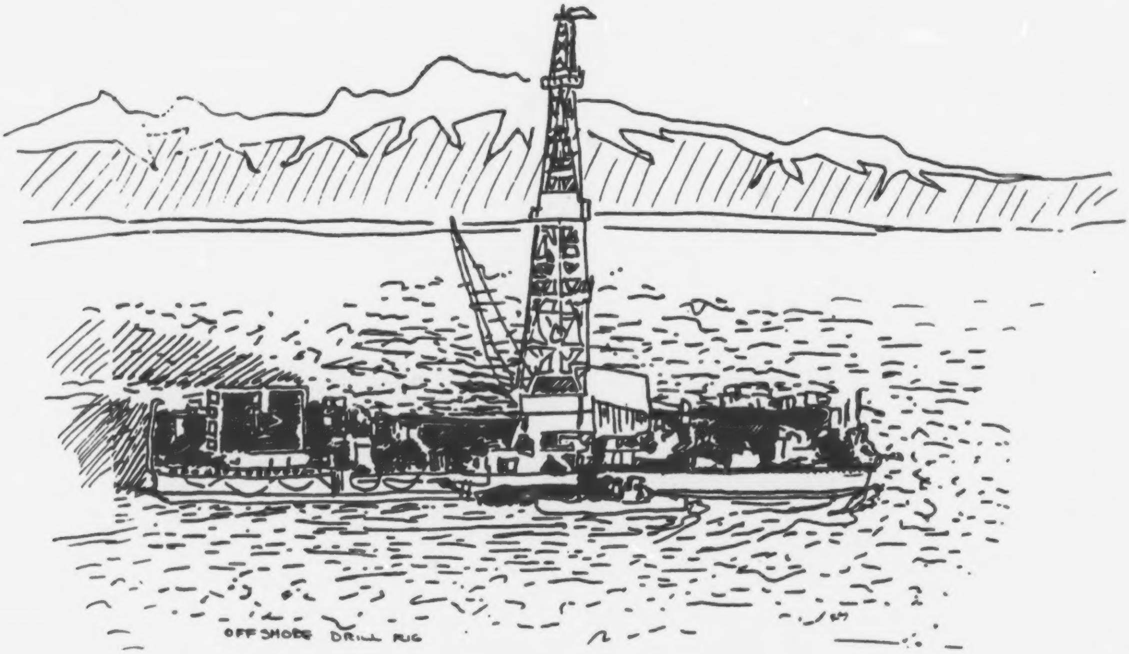
*26. Oil industry jobs might provide a way to _____ money in some villages.

*27. A possible supply base for oil development in Norton Sound is the city of _____.

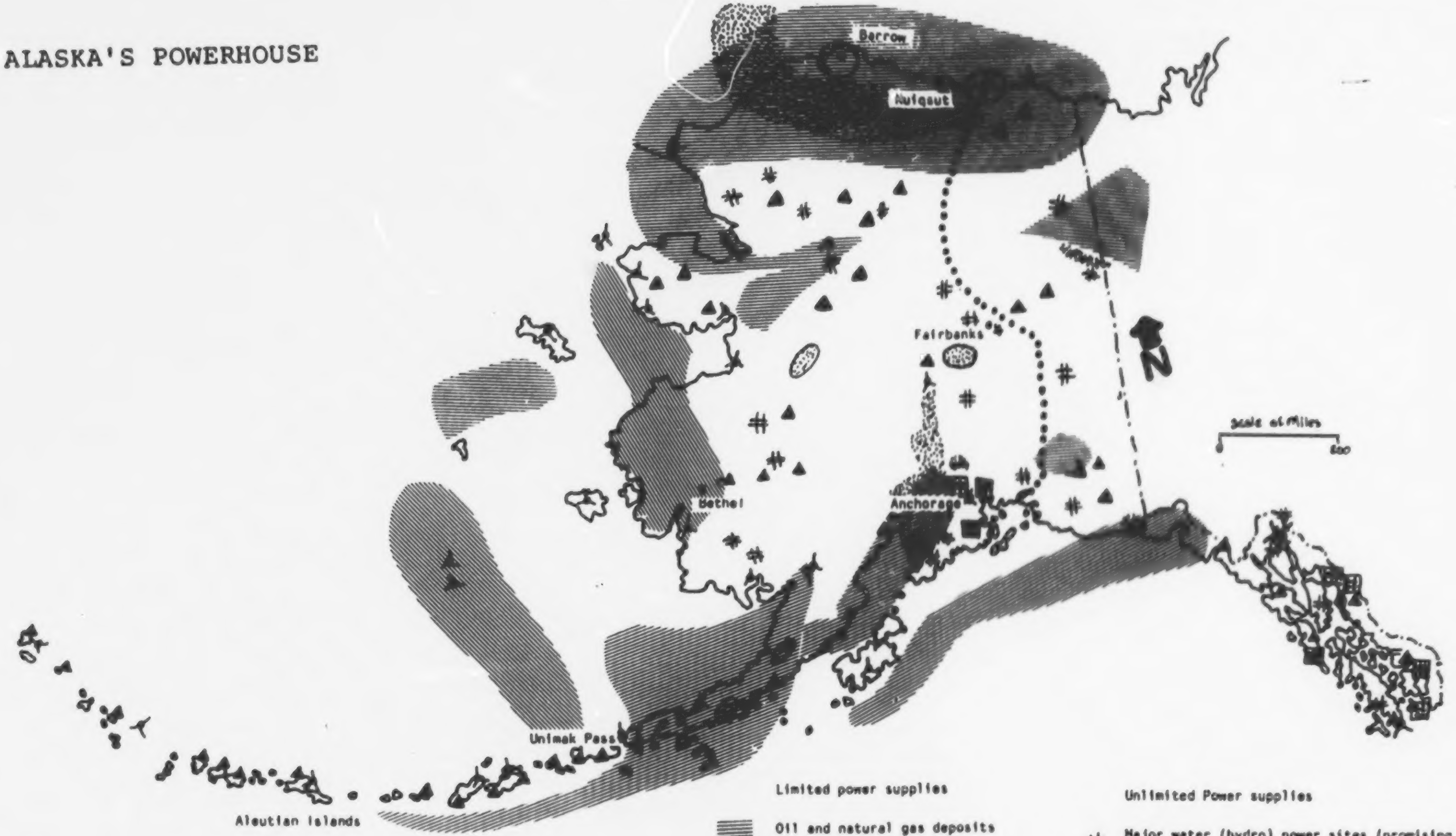
30. A land bird often called "wise old _____" (and probably a lot smarter than the fork-tailed storm petrel).

33. Okhotsk Sea (init.).

35. Alaska Industries (init.).



ALASKA'S POWERHOUSE


Barrow
Nuiqsut
Fairbanks
Bethel
Anchorage
Unimak Pass
Aleutian Islands
N
Scale of Miles
0
500
Limited power supplies
Oil and natural gas deposits (8.6 billion barrels of oil in measured reserves and 32 trillion cubic feet of natural gas in proven reserves*
Coal deposits (state estimates resource at 1.8-5 trillion short tons)
Producing fields
Oil refineries
Trans-Alaska oil pipeline
Unlimited Power supplies
Major water (hydro) power sites (promising areas for development)
Developed hydro
Hot springs or promising areas for geothermal power development
Windmill power-promising areas for development

Source: State of Alaska Division of Energy and Power Development

* Production and reserve figures derived from API and AGA data (American Petroleum Institute, American Gas Association and Canadian Petroleum Association, 1980)

Alaska's Powerhouse

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1. What kinds of natural energy seem to be the best bet for the Aleutian Islands?

   ____________________ and ____________________

   For Southeast Alaska? ____________________ and ____________________ (plus maybe some ____________________).

2. Using the scale of miles, figure out how long the Trans-Alaska pipeline is:

   ________ 500 miles

   ________ 800 miles

   ________ 1,000 miles

3. A fairly new refinery near Fairbanks processes some of the oil from the pipeline. But for most of its heat and power, Fairbanks still relies on fossil fuel from a producing field about 80 miles to the southwest. What kind of fuel is it?

   ____

4. The southcentral Alaska area around Anchorage is the most heavily populated in the state. It also has the widest variety of both fossil and renewable energy sources. What are they?

   ____________________, ____________________,

   ____________________, ____________________, and

   ____

5. So far, only one city in the Arctic has been able to use natural gas from nearby fields to heat its homes. What city is it? ____________________

6. Just living on top of oil, gas or coal deposits doesn't make your fuel all that handy. Two years ago the village of Nuiqsut near the Arctic coast ran out of fuel because the oil delivery barge couldn't make it up the Colville River. If that barge was delivering diesel from the refinery just south of Anchorage, about how far would it have had to

travel (via Unimak Pass) to get to Nuiqsut?

_______ 1,000 miles

_______ 2,000 miles

_______ 2,500 miles

About how far is it from Nuiqsut to the pipeline?

It is _______________ miles. (Oil companies helped out in the crisis by flying in emergency supplies from Prudhoe Bay.)

7. One of the biggest power projects on the state's drawing board right now is a hydroelectric dam development on the Susitna River. It is located about halfway between Anchorage and Fairbanks. Find its symbol on the map and draw a circle around it.

8. Write the name of your city or village on this map if it doesn't already appear. Are there natural power sources in your area that might be developed? ____________________ Do you know of others that aren't shown on this map? ____________________ (If so, check the list of symbols and draw them in.) What energy fuel(s) are you using now?

____

Sunpower in Alaska

5B

"SUN POWER IN ALASKA???" is excerpted and adapted from Alaska Tidelines, Volume III, Number 1, September 1980. Virginia Sims, editor. Published by the University of Alaska Sea Grant College Program, Copyright © 1980. Reprinted by permission.

OK, so Alaska has plenty of wind, water, hot springs and volcanoes to tap for natural power. But sun power? In the middle of winter? At Barrow--where the sun goes down in November and doesn't come up again until January?

Believe it or not, scientists say yes. Well, maybe yes. It is because of the surprising fact that sun (solar) power can be stored in earth, rocks and water.

Solar-heated homes aren't just warm when the sun is shining. That wouldn't do you much good. Instead, they are designed, first, to capture as much of the sun's radiant heat and light as possible, and, second, to trap the leftover heat in bins of earth and gravel or barrels of water for use at night or on cloudy days. Besides providing heat, solar energy can be converted to electricity by the use of photovoltaic cells. Excess energy is stored in batteries for use at night or on cloudy days.

The sun's energy can also be pulled out of the earth and water with a mechanical marvel called a heat pump. A heat pump is what makes your refrigerator work. It circulates and compresses a chemical called Freon, which becomes very hot and very cold as it changes from vapor to liquid and back again. In the process, it pulls the heat out of the food you put inside the refrigerator and releases it outside in the kitchen. (You can feel the heat on the coils at the back of the refrigerator.)

A ground-heat pump works in exactly the same way. And since you are actually refrigerating the ground while you're pulling the heat out, it doesn't make any difference whether the ground is frozen or not. (The food in the freezing section of your refrigerator is frozen, right?)

For a number of years, ground-heat pumps have been used to heat buildings in Scandinavian countries, where the climate isn't too different from ours. Now scientists at the University of Alaska's Geophysical Institute are working on ways to adapt those systems for use in Alaska.

Professor Hans Nielsen figures it would take about 1,000 feet of plastic garden hose filled with Freon, buried about six feet deep and spread out through a quarter of an acre of ground, to heat an average-sized home. "And if you could use a windmill to provide power for the heat pump, it would be perfect," Nielsen says.

For ground-heat pumps, solar heating, and solar electricity, energy needed for year-round use must be stored mostly in the summer. Does Alaska have enough sun power for this? What about Barrow? Check the figures in the table below and you might find some surprises.

5B

Read a Table

This table shows the average monthly amount of solar radiation (heat and light) received at four Alaska cities.*

1. Which city is the farthest north? ____________________ (Check the map if you're not sure. Palmer is about 40 miles northeast of Anchorage.) The farthest south? ____________________

2. Which city gets the most amount of sun in June and the least amount in December? ____________________

3. Cloud cover and shade from mountains and such can cut down on the sun's radiation. Which city gets the least sun power during May, June and July? ____________________ Draw a circle around the months on the table.

4. Which city gets the most solar energy during July, August and September? ____________________ Draw a circle around the months.

AVERAGE SUN POWER RECEIVED EACH MONTH
(measured in Langleys**)

	Barrow	Fairbanks	Palmer	Juneau
Jan.	1	17	36	51
Feb.	36	74	87	105
Mar.	183	219	220	194
Apr.	395	378	339	325
May	526	495	422	445
June	602	531	433	451
July	461	477	393	413
Aug.	267	338	307	303
Sept.	123	212	211	201
Oct.	43	85	112	109
Nov.	3	32	43	52
Dec.	0	6	17	34
Average	220	239	219	224

Source: University of Alaska, Institute of Agricultural Sciences

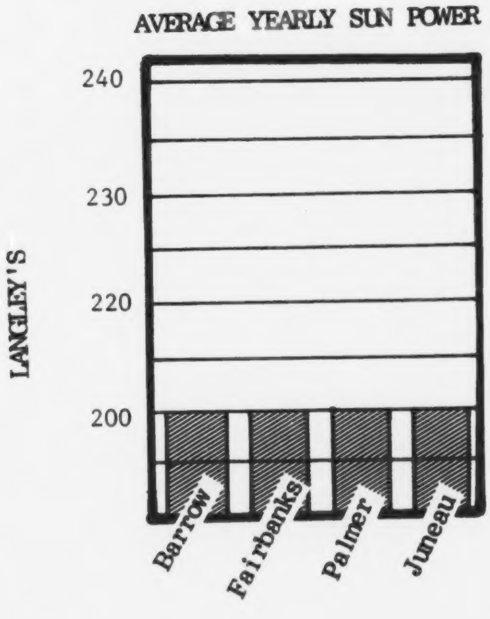
*Average daily amounts measured on a flat surface, 1960-1971.

**Solar radiation is measured in Langleys, named after U.S. scientist Samuel P. Langley (1834-1906). A Langley is a unit of energy equal to one gram-calorie per square centimeter. (A gram-calorie is the amount of heat needed to raise the temperature of 1 gram of water 1°C.)

Make a Graph

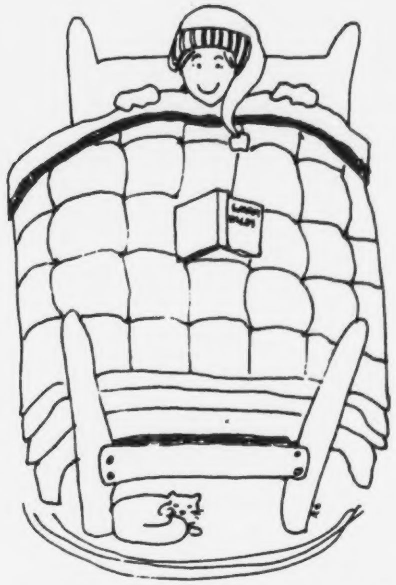
Complete this bar graph by using the figures on the bottom line of the table. Draw lines above each bar on the graph, marking the average yearly amount of solar energy each city receives. Then extend the bars up to the lines and fill them in.

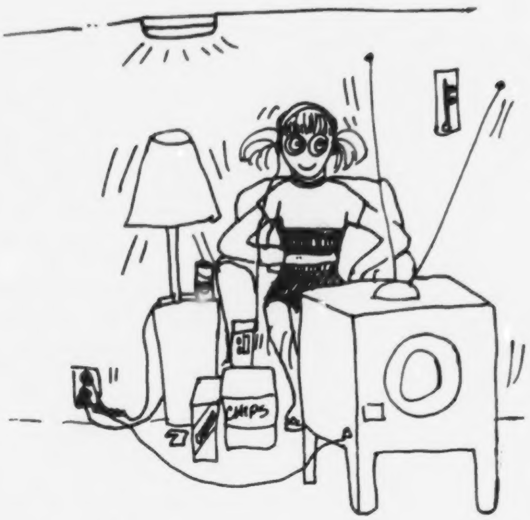
Would you say the midnight summer sun in the northern cities makes up for the long dark winters? ____________________



5C Energy Hog or Energy Hoarder

Read and mark the answers that best describe what you do to save or use energy. Then total up your points: 70 points or more and you're an energy hoarder; 30 to 69 points you're not too bad; 29 to -29 need some improvement; and -30 points or less you're an energy hog!





1. Do you turn the heat down and use lot of quilts and blankets at night? (7 pts) ________
   ...an electric blanket? (4 pts) ________
   ...or just keep the whole house warm? (-2 pts) ________

2. Do you grow some of your own vegetables? (5 pts) ________
   ...pick berries? (5 pts) ________
   ...hunt or fish for food? (5 pts) ________
   ...rely only on food from the Lower 48? (1 pt) ________

3. Do you eat food from the four basic food groups everyday? (5 pts) ________
   ...sometimes eat from the four basic food groups? (3 pts) ________
   ...like pop, candy and potato chips? (-1 pt) ________

4. In your spare time, do you always have your nose in a book? (5 pts) ________
   ...bicycle, hike, swim, jog, canoe, sail, or cross country ski? (5 pts) ________
   ...ride a three wheeler, in a car, motorboat, or on a snowmachine? (-5 pts) ________
   ...feel that your nose may one day become permanently glued to the tube (TV)? (-3 pts) ________

5. Is your house weatherstripped and caulked? (5 pts) ________
...real drafty? (-3 pts) ________
...or does it have holes big enough for voles to come in through? (-5 pts) ________
(subtract another 3 pts if the holes are big enough for weasels!) ________

6. Are your windows single-paned? (1 pt) ________
...visqueened? (1 pt) ________
...double-paned? (5 pts) ________
...triple-paned? (8 pts) ________

7. Give yourself a point for each inch of fiberglass insulation (or equivalent)
...in your roof ________
...in your floor ________
...in your walls ________
(if you have log walls, figure ½ pt for each inch of thickness)

8. Add 4 pts if your house has a vapor barrier. ________

9. Is the temperature in your house in wintertime*
...warm enough for bikinis? (-7 pts) ________
...OK for T-shirts and shorts? (-5 pts) ________
...cool enough for light sweaters? (3 pts) ________
...requires heavy sweaters and wool shirts? (5 pts) ________

*If your house is well insulated, you can still have it warm and be saving lots of energy, but there is such a thing as overheating!

10. Do you have a hot water heater? (-12 pts) ________
...add 5 pts if it's insulated ________
...add 5 pts if it's set at 120°F or less ________

11. Do you cook several dishes in the oven at once? (5 pts) ________
...use the oven for one large dish? (2 pts) ________
...or use it to make toast in the morning? (-1 pts) ________

12. Do you boil water with the lid on the pan? (3 pts) ________

13. After washing clothes, do you hang them on the line to dry?
...never (-1 pts) ________
...in good weather (3 pts) ________
...in any weather (5 pts) ________

5C

14. Do you turn off lights when you're not using them?
...never (-2 pts) __________
...sometimes (3 pts) __________
...always (5 pts) __________

15. Do you repair things when they break? (10 pts) __________
...or throw them away? (-5 pts) __________

16. Are your clothes
...from second-hand stores or hand-me downs? (8 pts) __________
...almost always new? (1 pt) __________
...only the finest designer specials? (-3 pts) __________

17. Do you recycle or reuse newspapers, cans, bottles, paper? (5 pts) __________

18. Do you shut off the TV or radio when you're not using them?
...always (3 pts) __________
...sometimes (-1 pt) __________
...never (-3 pts) __________

19. Subtract 3 pts for each gas or electric appliance in your house. __________

20. Do you have solar panels, wind generator, geothermal, hydropower, or a heat pump in your house? (15 pts) __________

21. Add 3 pts for each additional way you save energy. Write them here.

______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________
______________________________________ __________

22. Bonus question (15 pts). List at least 5 new ways you can save energy in the future.

______________________________ ______
______________________________ ______
______________________________ ______
______________________________ ______
______________________________ ______
______________________________ ______
______________________________ ______
______________________________ ______

Now total your points. ______

Are you a _____ energy hoarder? _____ not too bad? _____ need some improvement? or _____an energy hog?

5D

Beating the Energy Crunch

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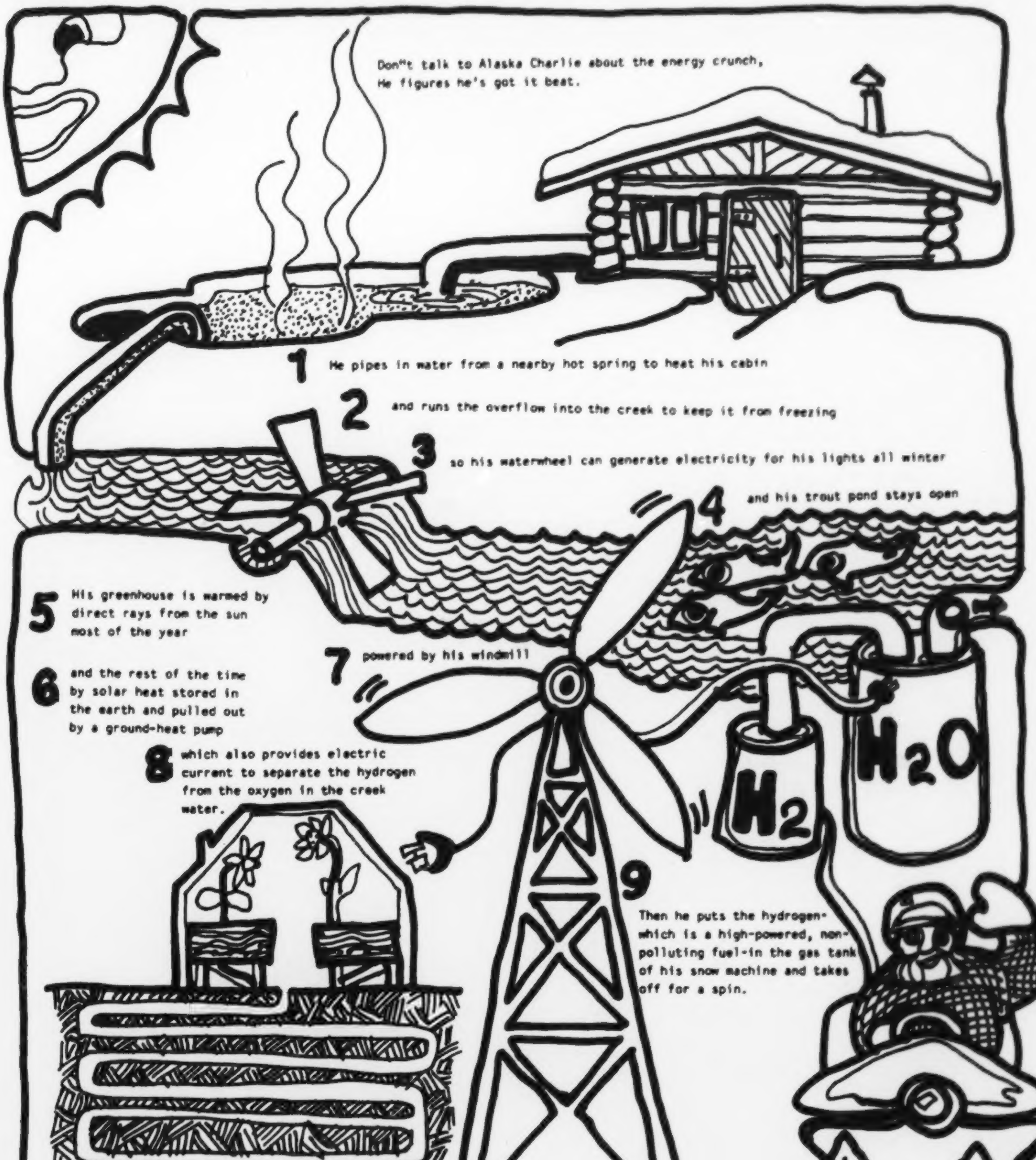


Don"t talk to Alaska Charlie about the energy crunch, He figures he's got it beat.

1 He pipes in water from a nearby hot spring to heat his cabin

2 and runs the overflow into the creek to keep it from freezing

3 so his waterwheel can generate electricity for his lights all winter

4 and his trout pond stays open

5 His greenhouse is warmed by direct rays from the sun most of the year

6 and the rest of the time by solar heat stored in the earth and pulled out by a ground-heat pump

7 powered by his windmill

8 which also provides electric current to separate the hydrogen from the oxygen in the creek water.

9 Then he puts the hydrogen-which is a high-powered, non-polluting fuel-in the gas tank of his snow machine and takes off for a spin.

So we can't all be as lucky as Alaska Charlie and plug in completely to nature's energy. But so what? Alaska is loaded with the usual kinds of energy fuels--oil, natural gas and coal. We have plenty for ourselves and enough to help fill the energy needs of the rest of the nation as well.

True. But there are a couple of problems.

For one thing, those fuels are all fossil (FAH-sull) fuels, made from the remains of plants and animals that lived millions of years ago. Sure, nature is still making fossil fuels. But we're using them up about a billion times faster than they are forming. The word "fossil" comes from the Latin fossilis, meaning "dug out." And once dug out and burned, they are gone forever.

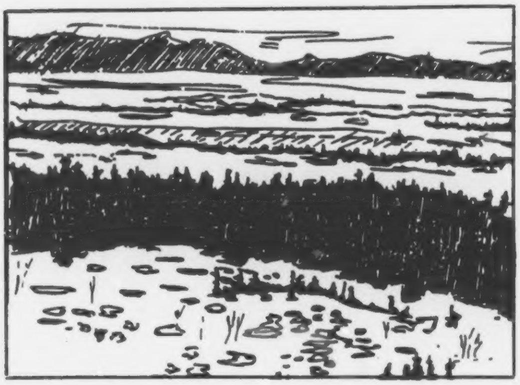
For another thing, even in Alaska those fossil fuels can be very expensive. Some cities, such as Anchorage, are able to use nearby natural gas fields for low-cost heat and power. But the majority of small towns and villages rely on oil to run their electric generators and heat their homes. And most of Alaska's oil flows right down the pipeline and out of the state for processing. By the time it gets back to rural Alaska, transportation costs have pushed fuel prices higher than anywhere else in the United States.

Now it's up to you. Design the house that you will build or want to live in 10 to 20 years--whenever you're ready to settle down. What will Alaska be like then? Label the location of your house and list energy-saving features.

5E

Local Wetlands

Directions: Label these drawings with the name of a local example (if there is one) and then the type of wetland (choosing from those listed at the bottom of the page).



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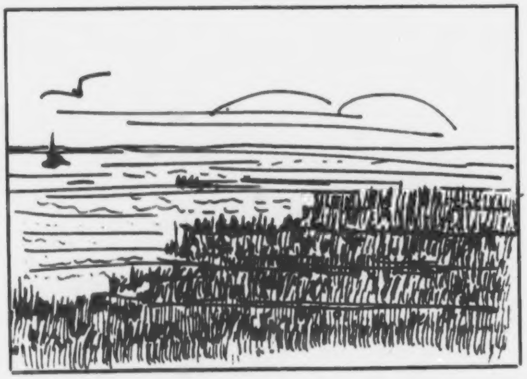

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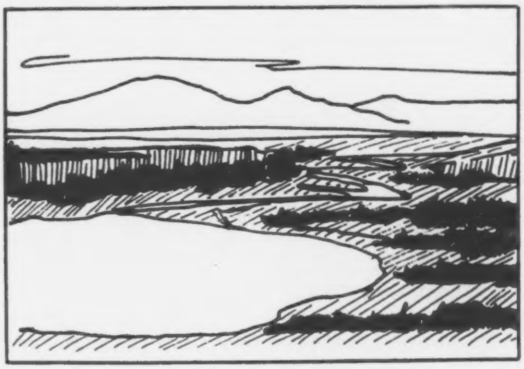

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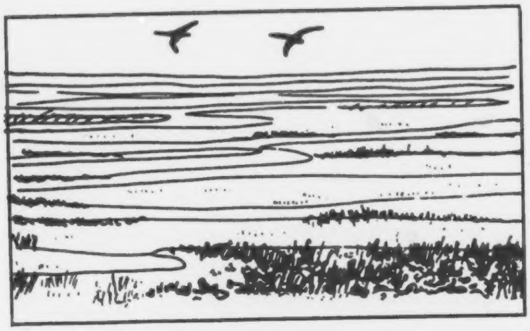


1.

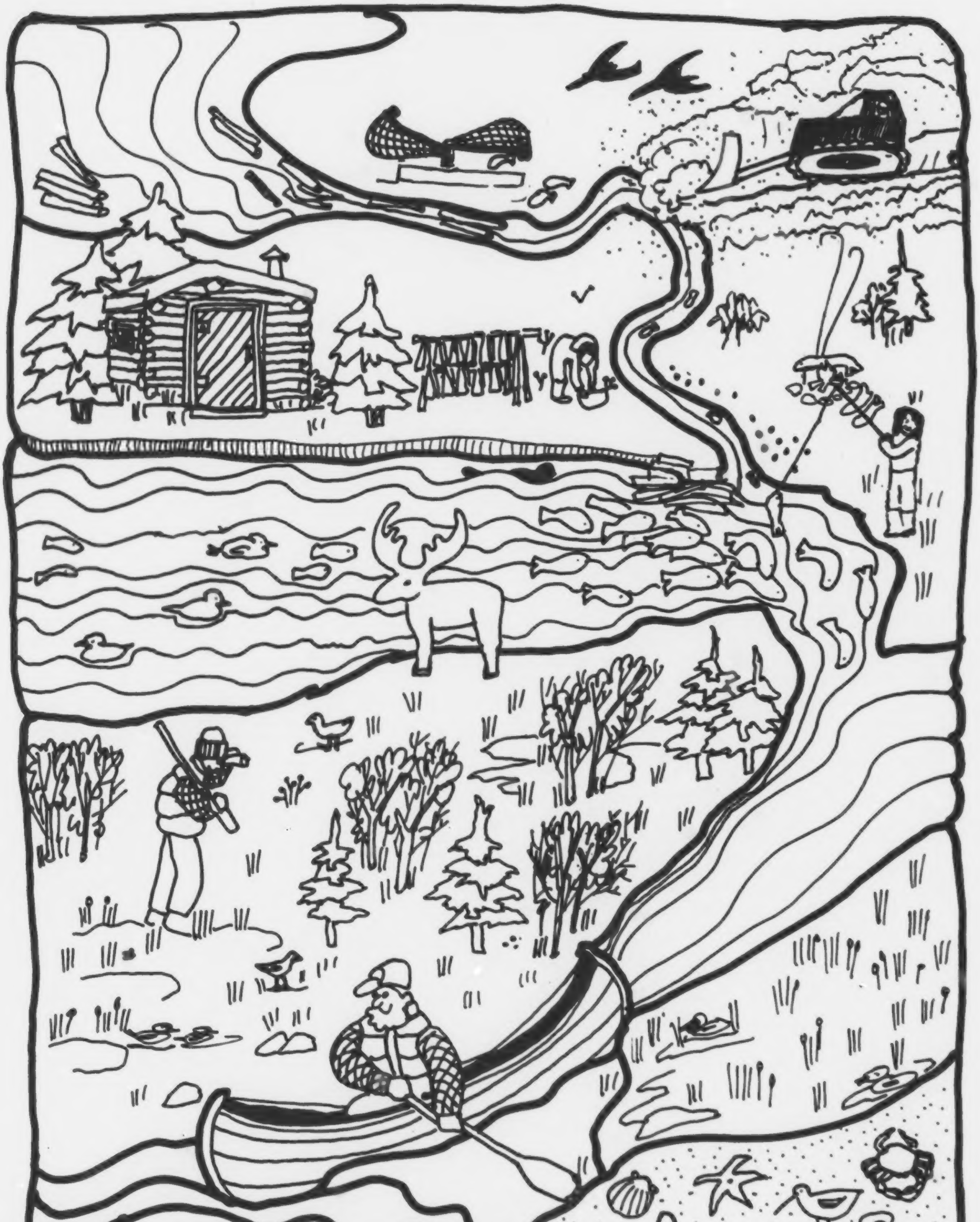
Coastal wetland - wetlands formed where land and salt water meet. Includes river deltas, salt marshes, tidelands and barrier-island lagoon systems.

Wet tundra - flat, treeless, water-soaked land, characterized by plants such as grasses, sedges, cranberry, blueberry, crowberry, lichens and tiny willows. These plants often grow in hummocks.

Rivers, lakes and marshes - freshwater wetlands that are formed in and along both flowing and still waters.

Muskeg - spongy or floating mats of vegetation such as sphagnum or "peat" moss, cranberry, Labrador tea, and sundew (a predatory plant). The water is highly acidic. Black spruce are often associated with Interior muskeg (lodgepole pine are found in Southeast muskeg). Sometimes muskegs are also called "bogs."

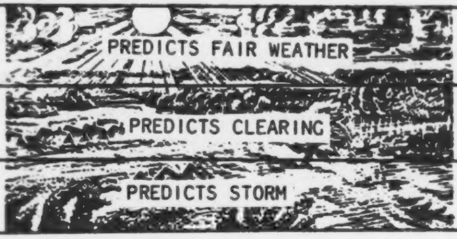
Life in a Wetland



6A

Weather Lore

People throughout the world have always been dependent on the weather in their day-to-day lives. Here are some folk sayings dealing with weather. Cut apart this sheet, and group the sayings by whether they predict fair weather, rain or storm, or clearing. Then tape or paste them by category on a fresh sheet of paper for a handy weather guide. (Hint: some of these sayings you may have to divide in half, as part predicts one way and part another!)



1. "Red sky in the morning,
Sailors take warning.
Red sky at night,
Sailors delight."

2. Rainbow to the windward,
Rain ahead;
Rainbow to the leeward
Rains end."

3. "Swallows flying way up high
Mean there's no rain in the sky.
Swallows flying near the ground
Mean a storm will come around."

4. "If smoke goes high
No rain comes by.
If smoke hangs low
Watch out for a blow."

5. "Sounds traveling far and wide
A stormy day will betide."

6. "Rain before seven,
Lift before eleven."

7. "When the dew is on the grass,
Rain will never come to pass.
When grass is dry at morning light,
Look for rain before the night."

8. "A veering wind: fair weather
A backing wind: foul weather."

9. When the air is humid, rain is more likely at low than at high tide. Falling tide reduces air pressure.

10. High visibility over salt water means rain is on the way. Salty haze is dispelled by unstable air currents.

11. Birds perch more before storms. Low pressure air is less dense, making it harder to fly.

12. "Higher the clouds, finer the weather."

13. Smells are stronger before rain. Odors held down by high pressure and escape as the pressure drops.

14. "A ring around the sun or moon
Bring rain or snow upon you soon."

15. "Short notice, soon past.
Long foretold, long last."

What's Your Climate?

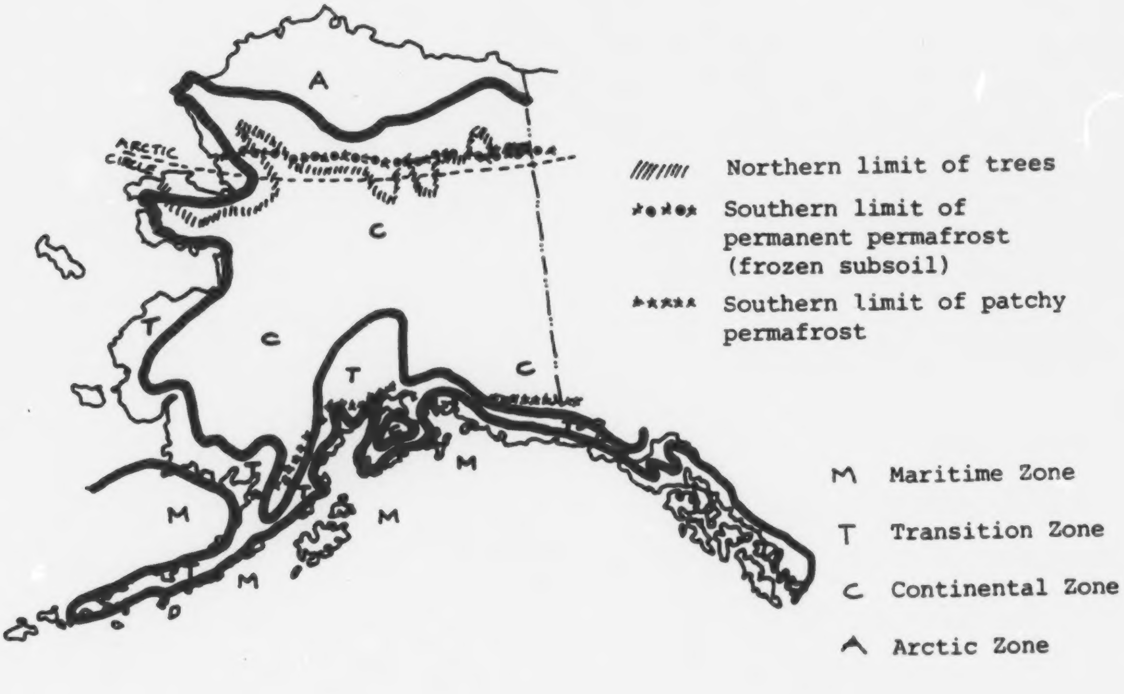
6B

"WHAT'S YOUR CLIMATE?" is excerpted from *Alaska Earthlines/Tidelines*, Volume V, Number 1, September 1982. Virginia Sims, editor. Copyright © 1982, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509, to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice, and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

Climate isn't the same thing as weather. Weather refers to conditions from day to day--wet, dry, hot, cold, wind, rain, snow and such. Climate is the combination of all these things as they occur over a long period of time.

If somebody asked you to describe the climate of Alaska, you would probably have to say, "What climate?" With or without any temperature changes, we have about as big a mix of climates as anybody could ask for.

For starters, Alaska has four major climate zones (see map): maritime (from the Latin *mare* meaning "the sea"); transition ("crossover"); continental and polar. But that doesn't begin to tell the story.


A
ARCTIC CIRCLE
C
T
C
T
C
M
M
M
M
///// Northern limit of trees
••* Southern limit of permanent permafrost (frozen subsoil)
***** Southern limit of patchy permafrost
M Maritime Zone
T Transition Zone
C Continental Zone
A Arctic Zone

Take Alaska's two major maritime zones at opposite ends of the map, for example. Deep dense rain forests of towering evergreens grow along the sheltered waterways of Southeast Alaska's Inside Passage. But far to the west, the Aleutian Islands have no trees at all and are swept by some of the highest winds in the world.

The position of the sun is an important factor in all the climates of the world. But here again Alaska goes to extremes. At Barrow, Alaska's farthest north city, the sun doesn't set at all between May 10 and August 2 (that's 87 straight days of daylight) and it doesn't rise from November 10 to January 24 (that's 67 straight days--uh, nights--of darkness).

Bodies of water usually serve as a source of moisture and heat for the land. But that doesn't quite work here, either. While two oceans and three seas wash the coastline of Alaska, our northern waters are covered by pack ice much of the year, which keeps the polar regions cold and dry.

Land forms like mountains, valleys, rivers and glaciers can create mini-climates within climates. And in Alaska they can play strange tricks. Several years ago, hurricane force winds funneling through mountain passes peeled roofs off houses in east Anchorage, while on the west side of town people didn't even have to hang onto their hats.

Find the location of your town or village and write it on the map. Which climate zone do you live in? ________________________

6B

Read the description of your climate zone. Is that the way you would describe the climate of your city or village if someone asked you what it was like? What would you say?

Martime Zone: Cool summers and relatively warm winters. Precipitation heavy--50 to 200 inches (mostly rain) along the coast and up to 400 inches (mostly snow) on mountain slopes. Strong winds over open areas.

Transition Zone: Mix of maritime and continental weather with temperatures and precipitation about in between, except for heavy snows in Gulf coastal areas. Bering Sea Coast climate is too severe to be maritime, but milder than Interior and polar areas.

Continental Zone: Summers quite hot (record, 100°F at Fort Yukon in 1915) and winters very cold (record, -80°F at Prospect Creek Camp in 1971). Winds and precipitation generally light.

Arctic Zone: Cold winters (average -15° to -18°F) and cool summers (average 30° to 40° above). Arctic ice pack usually closes in on shore in early October and retreats in mid-July. Snowfall light. Winds steady and strong along coast.

The preceding article is excerpted from Alaska Tidelines (see credit at beginning).

6C

Classifying Clouds

A scientist might say, "when air is cooled before it reaches its saturation point, the water vapor in it condenses to form clouds." But cloud formation can be explained more simply:

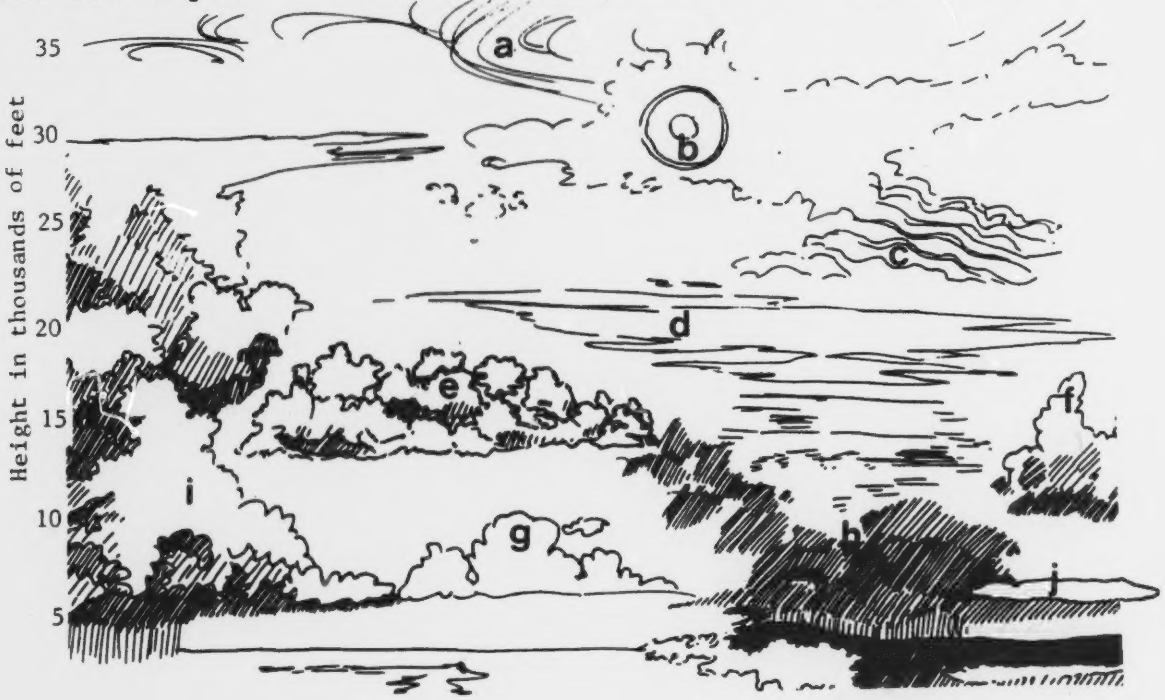
On winter days, your warm moist breath forms a miniature cloud when it hits the cold air. Similarly, when the moist warm air from a teakettle spout is cooled by the air around it, a little cloud forms. The clouds you see nearly every day form in the same manner.

Clouds are classified according to how they are formed. There are two main types. Cumulus clouds are formed by rising air currents. They are piled up and puffy. Stratus clouds are formed when a layer of air is cooled below the saturation point without moving up or down. They are in sheets or fog-like layers.

Clouds are again classified into high clouds, middle clouds, and low clouds, depending on their height. High clouds are made up almost entirely of tiny ice crystals. They average 20,000 feet above the earth. If cirrus is in a cloud's name, it is a high cloud. Alto, meaning high, is the prefix for the middle level clouds, which average 10,000 feet above the earth.

Low clouds range from near the earth's surface to 6,500 feet up. Nimbus, which means rain cloud, is in the name of clouds most likely to produce rain or snow.

Now see if you can match the descriptions with the pictures!



_____ 1. Altostratus clouds are dense veils or sheets of gray or blue. They often mean rain, especially with a northeast-to-south wind.

_____ 2. Nimbostratus clouds are the true rain clouds. They are darker than ordinary stratus and you can often see streaks of rain extending to the ground.

_____ 3. Cirrocumulus clouds are thin and patchy and often form wave-like patterns in what sailors call a mackerel sky. They aren't too dependable as a weather sign, except as a warning of change.

_____ 4. Stratus clouds are a low, quite uniform sheet, like a fog, with the base above the ground. Usually they mean a fine drizzle, until they turn into nimbostratus.

_____ 5. Cirrus clouds are thin, wispy and feather-like mare's tails. As long as they don't build up into thicker clouds, they mean that fair weather is likely to continue.

_____ 6. Stratocumulus clouds are composed of gray irregular masses of clouds spread out in a puffy layer. They don't produce rain unless they change into nimbostratus.

_____ 7. Altocumulus clouds are patches or layers of puffy or roll-like clouds that look like sheep's wool. Generally they mean fair weather, but when they thicken watch for rain or snow.

_____ 8. Cirrostratus clouds are long thin sheets that look like fine veils. Because they are made of ice crystals, they form large halos around the sun and moon. They mean precipitation within 15 to 20 hours.

_____ 9. Cumulonimbus is a towering thunderhead. Its base may almost touch the ground and violent updrafts may carry the top to 75,000 feet. It can take an hour or less to build up and produce a violent drenching storm with hail, thunder, and lightning. Rain will usually be over as quickly as it started.

_____ 10. Cumulus clouds are puffy, white clouds that mean fair weather, unless they pile up into cumulonimbus.

6D Track That Storm

"TRACK THAT STORM!" is excerpted from Alaska Earthlines/Tidelines, Volume 5, Number 1, September 1982. Virginia Sims, editor. Copyright © 1982, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509, to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice, and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

What makes our storms? Why do we have so many?

Any wind, of course, is simply the movement of air. Warm air is light and rises. Cold air is heavy and sinks. The winds of the world are caused mainly by these differences between temperatures of air masses. And in Alaska, with cold dry polar air moving down from the north and warm moist air moving up from the south, you have an ideal battleground of stormy pushing and shoving.

Knowing when and where these storms will strike is of vital importance to fishermen, farmers, bush pilots, hunters--and the rest of us, for that matter. Weather satellites give us an eye-in-the-sky view of where a certain storm is coming from and what it is doing at the moment. But to find out what is actually happening at the surface of the earth and to predict where the storm will go and what it will bring to your area, you should know how to read a surface weather map.

So give it a try. It's not as hard as it looks. Check these weather symbols and the ones on the last page to get an idea of what all those swirls and arrows and circles and flags mean. Then track that storm!

Weather Conditions

The circle at the end of the "flagpole" shows the cloud cover. Weather symbols are placed in the left of the circle.

○ Clear
⊗ Overcast
⊘ Partly cloudy
⦸ Mostly cloudy
● Cloudy

≡ Fog
• Light rain
∴ Rain
* Snow
⁂ Heavy snow

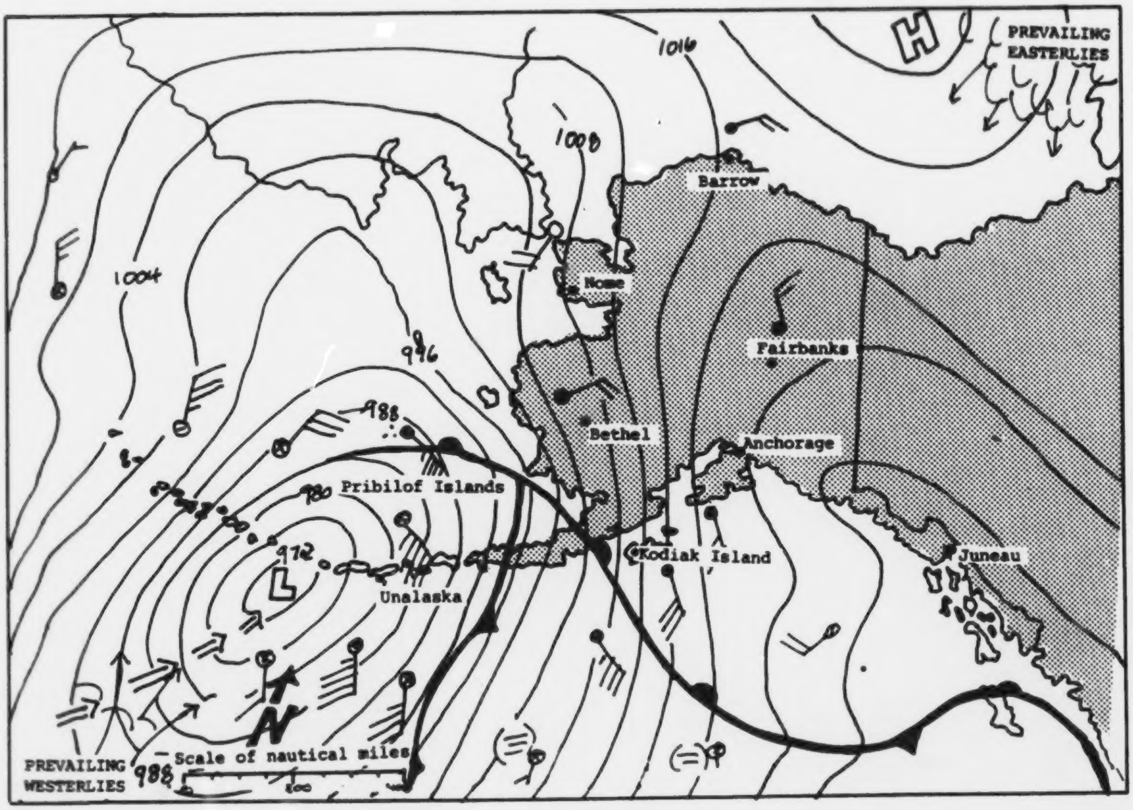
NOTE: Surface maps often include a lot more information--precipitation, air temperatures, sea temperatures, wave height, etc.--but that's too much for this space.

Here It Comes...

1. The weather map below shows a storm that moved in from the North Pacific on October 22, 1981. Like most Alaska storms, it was carried along by prevailing winds high aloft blowing from west to east. Use the "North" arrow on the map to line up your compass points. In which direction is this storm's low pressure center moving? (Check one) Toward the southwest_____. Toward the northeast_____.

2. The battleline where warm air masses and cold air masses push against each other is called a "front." When a typical winter cold front passes through, rain may change to snow followed by clearing weather. When a warm front passes through, snow may change to rain or drizzle. What kind of front is sweeping out ahead of this storm? __________ front. What kind of front is following along behind it? __________ front.

3. The air is lightest at the center of a low pressure system. As the heavier air around it presses in, the center air has no place to got but up. How heavy is the air at the center of this storm? __________ millibars. How heavy is the air pressure at nearby Unalaska? __________ millibars.


1016
H
PREVAILING EASTERLIES
1008
Barrow
Nome
1004
Fairbanks
996
988
Bethel
Anchorage
Pribilof Islands
980
972
L
Unalaska
Kodiak Island
Juneau
N
Scale of nautical miles
500
PREVAILING WESTERLIES
988

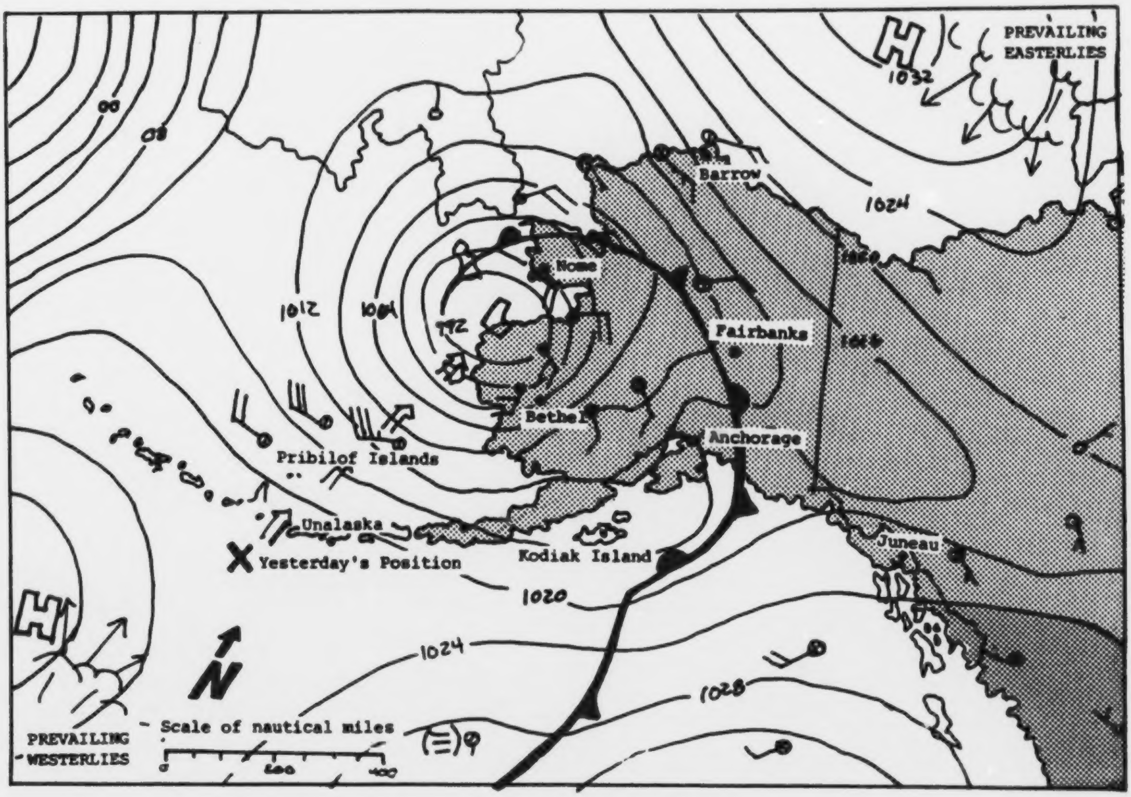
6D

4. Winds in a low pressure system don't all move in the same direction as the path of the storm. They whirl around the center like water going down the drain of a bathtub (except they "drain" upwards instead). Winds around a low pressure system move in a counter-clockwise direction. From which direction are the winds blowing at the Pribilof Islands? __________. How strong are they? __________ knots. What kind of precipitation is falling there? __________.

There It Goes...

1. As you can see on the weather map below, our storm began to die out over Norton Sound on October 23. (It wasn't a very big storm by Alaska standards, but it was typical for early fall.) Using the scale of nautical miles, figure out how far the storm center traveled in 24 hours: __________ nautical miles.

2. By now part of that cold front has caught up with the leading warm front and we have a mix. From Nome to the Gulf Coast it is an __________ front. From the coast to south of Kodiak Island it is a __________ front.


H
1032
PREVAILING EASTERLIES
00
08
Barrow
1024
1020
1016
Nome
1012
1004
992
Fairbanks
Bethel
Anchorage
Pribilof Islands
Unalaska
Yesterday's Position
Kodiak Island
Juneau
1020
1024
1028
H
N
PREVAILING WESTERLIES
Scale of nautical miles
0
200
400

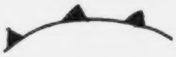
3. Judging from that high pressure system moving down from the north, it looks like fair weather might be ahead for most of Alaska. A high pressure center is just the opposite of a low pressure center. In a high, the pressure in the middle is the heaviest and the winds push outward, this time blowing in a clockwise direction. How heavy is the air pressure at the center of the high? __________ millibars. How heavy is the air pressure at Barrow? __________ millibars. How strong is the wind there? __________ knots. What is the cloud cover? __________.

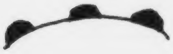
WEATHER SYMBOLS

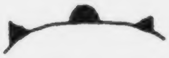
H High pressure center

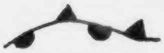
L Low pressure center.

⇒ Direction and speed of high and low centers.

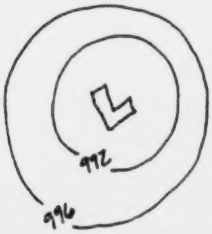

Cold front (cold air pushing warm air out of the way).


Warm front (warm air pushing cold air out of the way).


Occluded front (cold front overtaking a warm front).


Stationary front (not moving--a stand-off).

Isobars--lines of equal pressure.

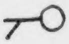


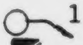
The word "isobar" (EYE-so-bar) comes from the Greek isos, meaning "equal" + baros, meaning "weight" or pressure.

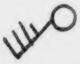
Numbers on the isobars show sea level pressure in millibars (1,000 millibars = 29.53 inches of mercury on your barometer, or about 15 pounds of air pressure).

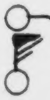
Wind Direction and Speed in Knots
(Knots are nautical miles per hour)

Wind speeds are shown by the little lines running out like flags on a flagpole. One-half line = 5 knots; one full line = 10 knots. The flagpole itself is pointed in the direction the wind is blowing.


5 knots from the west


10 knots from the east


35 knots from the southwest


65 knots from the north
(black flag = 50 knots)

The preceding article is excerpted from Alaska Tidelines (see credit at beginning).

6E

Make Your Own Weather Instruments

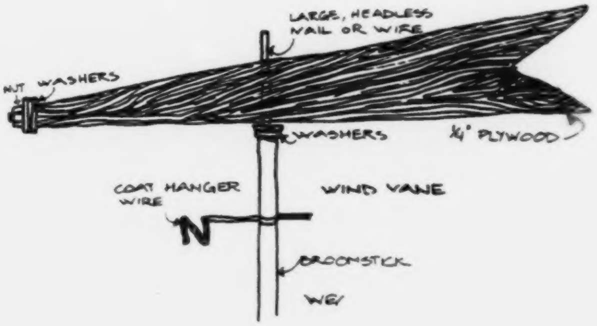
WEATHER VANE:

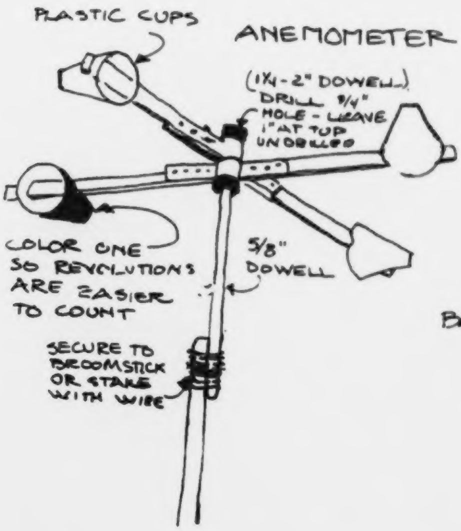
Two important points to remember are:

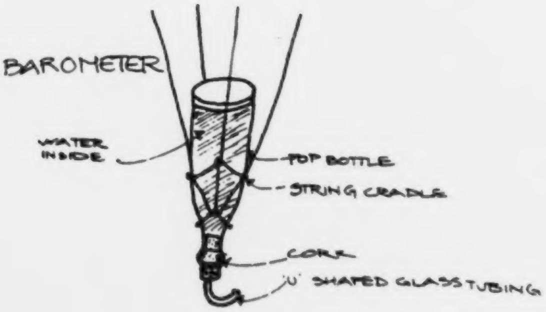
1. The vane must move freely and easily on its axis, with the front pointing into the wind.

2. The vane part must be in balance.

Use a compass to figure true north and don't forget to figure declination.


LARGE, HEADLESS NAIL OR WIRE
NUT WASHERS
WASHERS
¼" PLYWOOD
COAT HANGER WIRE
WIND VANE
N
BROOMSTICK


PLASTIC CUPS
ANEMOMETER
(1¼-2" DOWELL) DRILL ¼" HOLE - LEAVE 1" AT TOP UNDRILLED
COLOR ONE SO REVOLUTIONS ARE EASIER TO COUNT
5/8" DOWELL
SECURE TO BROOMSTICK OR STAKE WITH WIRE


BAROMETER
WATER INSIDE
POP BOTTLE
STRING CRADLE
CORK
'U' SHAPED GLASS TUBING

BAROMETER:

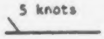
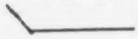
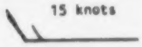
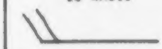
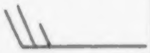
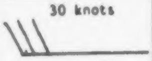
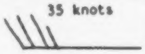
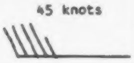
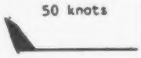
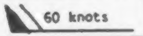
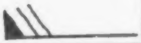
An old-fashioned weather glass is easy to make.

When the air pressure is low, water drips out of the tubing. When the air pressure is high, water is held back in the tubing.

ANEMOMETER:

In the cup anemometer, the openings of the cups catch the wind, and the wind forces the cups to revolve. The number of revolutions per minute gives you the wind speed. To figure out the wind speed of your anemometer, hold it out the window and count the revolutions per minute. Then check with your local weather station and find out the wind speed for that day.

BEAUFORT SCALE OF WIND EFFECTS

mph	knots	Beaufort number	Land Observations	Sea Observations	Symbols on weather maps
0-1	0-1	0	smoke rises straight up	sea is mirror smooth	◎ calm
1-3	1-3	1	smoke drifts slowly but weather vanes don't move	ripples like scales but without foam crests	◎ calm
4-7	4-6	2	wind felt on face; leaves rustle; wind vane moves	short, more pronounced wavelets	 5 knots
8-12	7-10	3	leaves and twigs in motion; wind extends light flags	large wavelets; crests begin to break with glassy foam	 10 knots
13-18	11-16	4	small branches move; wind raises dust and loose	waves are longer with many whitecaps	 15 knots
14-24	17-21	5	small trees sway; crested wavelets appear on small lakes	moderate waves; white foam crests	 20 knots
25-31	22-27	6	large branches move; telegraph wires whistle; umbrellas hard to control; very choppy lake waters	large waves, more extensive foaming crests; probably some spray	 25 knots
32-38	28-33	7	whole trees in motion; walking into wind becomes difficult	sea heaps up; foam begins to blow in streaks	 30 knots
39-46	34-40	8	twigs break off trees; large objects hurled across ground	higher, rolling waves; foam blows in thick streaks	 35 knots
47-54	41-47	9	branches break, slight structural damage (roof slates may blow away, etc.)	high waves, tumbling crests, dense blowing foam	 45 knots
55-63	48-55	10	trees uprooted, considerable damage occurs; seldom experienced inland	high waves with long overhanging crests; great foam patches	 50 knots
64-72	56-63	11	widespread damage	waves so high that ships are hidden in the troughs air completely filled with foam and spray, sea completely white with driving spray	 60 knots
73-82	64-71	12	extreme damage		 70 knots

Another method is to get the help of a car driven on a calm day. Hold your anemometer out of the car window and count the revolutions per minute at different speeds. One difficulty with this method is that the wind eddies outside the car windows will influence your results. Is there any way you can correct this?

____

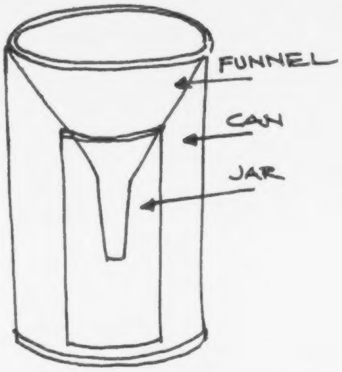
If you live in a windy area, and the anemometer often goes faster than you can count, you may have to attach some gears to slow it down. Try using a household egg beater.

What is the description of your wind today on the Beaufort Scale? ____________

BEST COPY AVAILABLE

RAIN GAUGE:

Calibrate your rain gauge by pouring 1/2 inch of water in the bottom of the empty can. Then pour that amount of water through the funnel. The water will reach the 1/2 inch level in the jar. Mark it with a waterproof felt-tip marker or a piece of tape. Continue with the same procedure for 1/4 inch, 3/4 inch and 1 inch. Rainy areas of Alaska may need larger rain gauges!

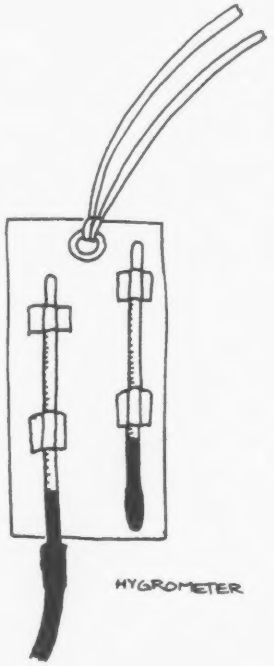


HYGROMETER:

This must be made strong enough so you can swing it back and forth. To use it, first wet the base of the thermometer with the shoelace on it. Then swing it back and forth for four to five minutes. Record the temperature of each thermometer. Then use the following chart to figure relative humidity:

TABLE OF RELATIVE HUMIDITY – MEASURING MOISTURE

Difference between wet-bulb and dry-bulb readings	Temperature of air, dry-bulb thermometer, Fahrenheit							
	30°	40°	50°	60°	70°	80°	90°	100°
1	90	92	93	94	95	96	96	97
2	79	84	87	89	90	92	92	93
3	68	76	80	84	86	87	88	90
4	58	68	74	78	81	83	85	86
6	38	52	61	68	72	75	78	80
8	18	37	49	58	64	68	71	71
10		22	37	48	55	61	65	68
12		8	26	39	48	54	59	62
14			16	30	40	47	53	57
16			5	21	33	41	47	51
18				13	26	35	41	47
20				5	19	29	36	42
22					12	23	32	37
24					6	18	26	33



Keeping Watch on the Weather

6F

Weather Recorder's Name ______________________

Date					
Time					
Temperature					
Cloud Type					
Wind Direction					
Wind Speed					
Precipitation (inches/ 24 hours)					
Barometric Pressure					
Relative Humidity					
Present Weather Conditions					
My Predictions for Tomorrow					

6G Buy Bikinis or Haul Out Your Parka?

"BUY BIKINIS...OR HAUL OUT YOUR PARKAS?" is excerpted and adapted from Alaska Earthlines/Tidelines, Volume V, Number 1, September 1982. Virginia Sims, editor. Copyright N 1982, The Alaska Geographic Society, Robert A. Henning, president. All rights reserved. Special permission has been granted by The Alaska Geographic Society, Box 4-EEE, Anchorage, Alaska 99509 to allow duplication of this worksheet for classroom use from 1984 through 1986. Each duplicate must bear this copyright notice and the permission for such duplication does not extend to any other material on which The Alaska Geographic Society holds copyright.

For a number of years now, scientists have been keeping a wary watch on the buildup of carbon dioxide (DIE-ox-ide) in the atmosphere--the air that surrounds the earth. Carbon dioxide is an invisible, odorless gas made up of one part carbon and two parts oxygen (CO_2). Normally it serves as a life-giving link between plants and animals (including people). We breathe in oxygen and breathe out carbon dioxide. Plants absorb the carbon dioxide (which they need to grow and make food) and give off oxygen--and everybody benefits.

When living things die or decay or when once-living things--such as wood from trees--are burned, they give off carbon dioxide. Fossil fuels, such as coal and petroleum, were formed from the remains of once-living things too. So about 100 years ago when we started burning great quantities of coal, oil and gas in our factories, homes and automobiles, that neat balance of oxygen and carbon dioxide began getting off kilter. Clearing the lands and forests to make way for more cities and people just added to the problem.

What does all this have to do with our weather? When you turn a lot of carbon dioxide loose in the air, strange things are apt to happen. The air still lets the sun's radiant energy rays through to heat the ground. But it partly blocks the reflected heat from the earth that would normally flow freely back into space. This creates what scientists call a "greenhouse effect" because the carbon dioxide holds the warm air in--just like the glass or plastic sheeting on a backyard greenhouse.

Carbon dioxide makes up only the tiniest part of our atmosphere, but it has been building up at an alarming rate. Since the early 1900s carbon dioxide in the air has risen from 290 to 340 parts per million (ppm). It is now rising by about 3 ppm each year. And it doesn't take much to make a difference.

In spring of 1982 more than 30 of the nation's scientists met at the University of Alaska in Fairbanks to discuss the carbon dioxide problem. They couldn't agree on whether or not the recent five-year warm spell in Alaska was caused by the carbon dioxide buildup. But they did make some predictions about what might happen to the world's weather in general, and to northern areas such as Alaska in particular, if and when the carbon dioxide warming trend really gets going. (Those predictions are based on a couple of big "ifs"--IF the present rate of buildup continues, and IF all other forces that affect the weather stay about the same.)

This may sound like science fiction stuff, but they said that by the time most of you are grandparents--or at least by the middle of the next century--the earth as a whole could be 4 to 5 degrees warmer and Alaska could be 9 to 15 degrees warmer!

The scientists said that the most dramatic changes would be felt in all regions north of 60° Latitude, including most of Alaska. (Trace 60° Latitude on a world map and you will see that it runs just north of the Southeast Panhandle, crosses the middle of the Kenai Peninsula just south of Ninilchik, and passes out into the Bering Sea over Nunivak Island. What other areas of the world would be included?) ________________________________

They explained it this way:

In northern areas the warming trend would reduce the number of months the ground is covered by snow. The bare ground, in turn, would absorb more heat, speeding up the process. Meanwhile, the normal offshore ice pack would shrink back, first on the Bering Sea and then on the Arctic Ocean. (While large bodies of water don't absorb heat as fast as land masses do, they hold it longer and have a huge storage capacity.) And finally perhaps, for the first time in three million years, the Arctic Ocean might be completely free of ice in the summertime. (Scientists estimate that a permanent rise of another 7° to 9° could do the trick.)

Unfortunately, it might not all be bikini weather. Warm air and open water also increase evaporation, which usually brings more clouds and more rain or snow. So while winters could be warmer, the summers could be cooler and wetter.

Would these changes be good or bad? It depends.

Ice-free northern waters would certainly be a boon to shipping and water transportation. (Can you imagine state ferry service into Barrow?) Offshore oil developers would have less to worry about. It would be tough on subsistence seal hunters and whalers. But commercial fishing fleets might appear off our Arctic shores for the first time--although the warmer water temperatures might have some affect on our current fish populations.

Melting permafrost would leave us with a lot of cracked-up, lopsided buildings, bridges, highways, airports and such, which would have to be replaced. On the other hand, forests and the wildlife they support would slowly spread north into now frozen tundra regions. With warmer soil, mild temperatures and longer growing seasons, farming could become one of Alaska's major industries.

The melting ice and snow could cause the oceans to rise--perhaps six inches by the end of this century. That would flood low-lying coastal areas. But the change would be gradual and could be handled with some relocation. (However, if the ice at the South Pole melted, it would be a different story. That would raise the world's sea level 18 feet.)

Too far out? Well, there are already early signs of some of these predictions coming true. In the eastern Bering Sea, surface water temperatures have been rising since 1976 and the winter ice cover has been smaller. Shallow permafrost has "warmed up" several degrees in many parts of Alaska. And everybody knows the past few summers have been unusually sloppy and yukky.

Haul Out Your Parkas...

The funny part of all this is that our warm spell came at a time when many scientists predicted our climate should be cooling off. They say that at no time during the earth's long history have we gone for more than 10,000 years without an ice age--and that one is now definitely overdue.

What brings on an ice age? Nobody really knows. But a popular theory is that ice ages are timed to slight shifts in the earth's great oval orbit around the sun and slight wobbles in the tilt of its polar axis. Just a small increase in the angle of tilt toward the sun (warmer) or away from the sun (colder) can make a big difference in the temperature of our northern latitudes.

Using models based on the laws of orbital mechanics, scientists have found that ice ages past followed these wobbles and shifts in the earth's movements. And the models insist we're in for another one.

Indeed, Alaska's five warm years came right on the heels of a 30-year stretch of unusually cold weather that ran from 1945 to 1975. But it could be, of course, that without the carbon dioxide buildup in the atmosphere, we already would be piling on the parkas.

Stick With the Jeans...

Not to worry, say many weather watchers. We've had warm spells and cold spells, long cycles and short cycles since Year 1. And 80 years of record-keeping in Alaska are just a drop in the bucket. There are many things, they argue, that affect our climate--and we have a lot more to learn about all of them before we make solid predictions. Here are just a few examples:

> Sunspots - These are dark blotches of different sizes that seem to move across the sun's fiery surface. Actually, they are violent storms of electrified gases with such a strong magnetic force that they can disrupt communications and radio and TV reception here on earth.
>
> Usually they change in cycles of 11 years, and our warm weather cycles seem to come at the peak of sunspot activity. (We are now easing off such a peak.)

> Air currents/water currents - High in the sky is a great 300-mile-wide river of wind called the "jet stream," which sweeps around the globe from west to east. Pilots of east-bound planes often take advantage of these tail winds, which may top speeds of 250 miles an hour.
>
> Normally the jet stream circles the earth at around 40° Latitude (over mid-America). But when it veers off track--as it did during that weird winter of 1976-77 when it shifted to a direction of southwest to northwest--it can change weather patterns.
>
> Changes in ocean currents and ocean temperatures also seem to affect the climate, but we're not sure how.
>
> "Dirt" in the air - Anything tossed up into the atmosphere--ash from erupting volcanoes, blowing sands from deserts, dust and dirt from cleared lands--tends to shade the earth from incoming sunlight and cool things off.

So take your pick. Will Alaska be warmer, colder, or about the same? Only time will tell.

But many scientists believe major changes are in the works--and that we'll be able to tell within our lifetimes what will happen next.

William Kellogg of the National Center for Atmospheric Research at Boulder, Colorado, one of the scientists who attended the conference on carbon dioxide at the University of Alaska in the spring of 1982, put it this way:

> The globe will be a lot warmer by the year 2000 than at any time in the last 1,000 years, with warmer winters and cooler summers. Nobody will doubt the reality of it within the next 10 years."

Well, we'll see. But meanwhile, you might want to keep an eye on your own thermometers.

This article was reviewed for content and scientific accuracy by Glenn Juday, visiting associate professor and ecological reserves coordinator, Agriculture Experiment Station, University of Alaska, Fairbanks.

The preceding article is excerpted from Alaska Tidelines (see credit at beginning).

6G

Answer the questions and fill in the blanks.

1. List two ways in which air pollution could change our weather.

   a. ______________________________

   b. ______________________________

2. What gas is given off when living things die, decay, or are burned?

   ____

3. Draw a picture to explain what the "greenhouse" effect is.

4. What would be the effects of a warming trend on northern areas? (List at least five)

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

5. What is the longest time the earth has ever gone without an ice age? ____________

6. What is one way scientists think an ice age could happen?

   ____

   ____

7. a. What are sunspots? ____________________

   b. What do they do to our temperature? ____________

8. What do you predict will happen to our Alaskan climate in the future?

____

____

____

6H

Water and I

1. How much water do you use every day? I estimate that I use ___________ gallons of water.

2. How would you figure out how much water you use?

____

____

____

____

3. Keep track of how much water you use in a day--using the method you devised. I use ___________ gallons of water per day.

4. What ways could you conserve water?

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

5. Now try to conserve water for a day and keep track of your use.

   a. I used ___________ gallons of water per day by conserving water.

   b. I saved ___________ gallons of water today.

   c. If you conserved water every day, how many gallons would you save in a year? ___________

6. The average American family uses 70 gallons a day for each member of the family.

   a. How many gallons a day would your family use if each member used the average amount? ___________

   b. How many gallons a day does your family use?

   ____

   c. How many gallons a year, on the average, is used by American families the size of your family? ___________

d. How many gallons per year does your family use?

____

e. How many gallons per year could your family save?

____

7. If every family in your community saved as much water in a year as your family, how many gallons would that be?

____

8. Why is it important to save water?

____

____

____

____

____

____

____

____

____

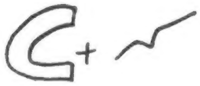
____

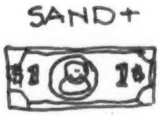
7A

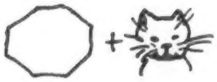
Ocean Word Images

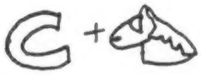
by Ruth Berman and her students

Directions: Write what each image represents in the blank below the drawing.

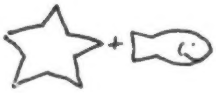


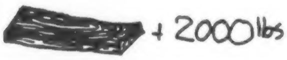


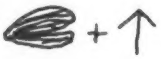


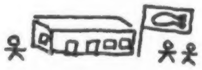


1.____________ 2.____________ 3.____________ 4.____________

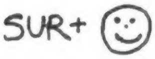


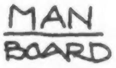


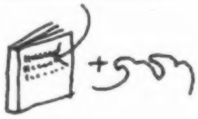


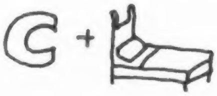


5.____________ 6.____________ 7.____________ 8.____________

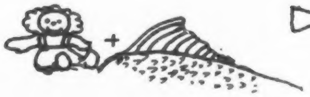


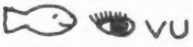


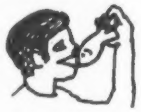


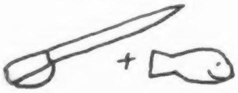


9.____________ 10.____________ 11.____________ 12.____________

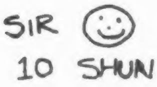


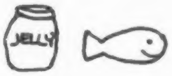






13.____________ 14.____________ 15.____________ 16.____________





17.____________ 18.____________

Aquatic Habitats

7B

See if you can solve this magic squares puzzle! Match the lettered words with the numbered phrases. Then place the matching numbers in the squares below. Add each row across and each column up and down. All of these totals should be the same if your magic squares are correct. The magic number is _____.

A. tide	B. erosion	C. current
D. watershed	E. lake	F. bog
G. wave	H. estuary	I. river

1. Always on the move carrying water across the land.
2. Area of land that feeds a river with water.
3. Wearing away of the land.
4. A temporary, watery part of the landscape continually filling with sediment.
5. Great stream of moving water that flows through the ocean.
6. Big ripple made by the wind.
7. Periodic change in sea level.
8. A wetland more productive than any corn or wheatfield.
9. Sphagnum moss heaven.

10. List five reasons why each of the following habitats is important:

seas	rivers	wetlands

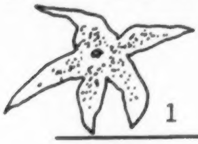
11. On another sheet of paper, draw a local pond or stream and at least eight invertebrates, one amphibian, five mammals, five birds, five fish, and five plants that live in or around it.

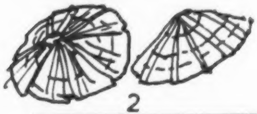
7C

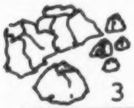
Marine Invertebrates

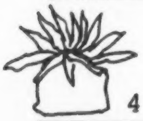
Adaptations enable an organism to survive in its environment. Write the correct name next to each illustration below, and draw a line to the description of each animal's major adaptation.

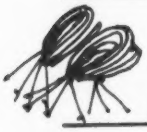
Discuss additional adaptations of the organisms and those of other marine animals.

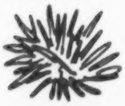

1 ______________________

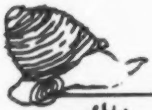

2 ______________________

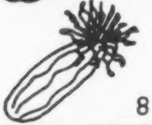

3 ______________________

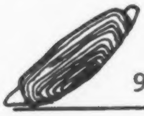

4 ______________________

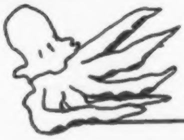

5 ______________________


6 ______________________


7 ______________________


8 ______________________


9 ______________________


10 ______________________

A. Byssal threads prevent these creatures from being washed away.

B. Strong, muscular "foot" enables it to dig into ground rapidly.

C. Pointed spines ward off predators.

D. Everts (sticks out) its stomach and inserts it between shells of bivalves to obtain food.

E. Adults secrete glue to permanently attach themselves to rocks, pilings or boats.

F. Defense from its predators is to eject (throw up) its insides.

G. Stinging cells in tentacles are used to capture food and fight away predators.

H. Radula with sharp points are used to scrape food off rocks.

I. Operculum protects it from predators and from dehydration at low tide.

J. Body colors change to match surroundings to camouflage itself.

Mollusks

7D

Directions: Fill in the blanks with the correct word chosen from those listed below. Some words must be used more than once.

bivalve
octopi
snails
mollusks
limpets
squid
chitons
univalves
clams
foot
cockles
siphons

The shell-bearing animals of the sea are called ______________. In every case, these animals have soft bodies and they usually have a large muscular foot on which they move. Their bodies are usually protected by a limy shell that the animal makes. Sometimes, however, the shell may be internal, or it may be absent. Four kinds of ______________ are found in shallow Alaskan waters. They are described below:

1. Animals with one part to their shells are called
(a) ______________. These include such animals as
(b) ______________ and (c) ______________.
(d) ______________ are animals with coiled shells, found in many shapes and sizes. (e) ______________, which are sometimes called Chinamen's hats, have cone-shaped shells and feed by scraping microscopic material from rocks or other surfaces.

2. Unlike (a) ______________, which have one part to their shells, (b) ______________ have shells with two parts or valves. Many of these animals, such as (c) ______________ and (d) ______________, live buried in the sand or mud. They have a large (e) ______________, which is used to dig deep beneath the beach surface, and two (f) ______________, which are often part of a neck that reaches to the sand or mud surface. Thus, the animal can take in sea water and remove from it the tiny food particles it needs to live.

3. Animals with eight plates or parts to their shells are called (a) ______________. The plates are usually visible, but sometimes they are partly or entirely covered by softer parts of the animal's body. (b) ______________ usually live in rocks, often in areas of heavy waves. Because they can cling tightly and shape to the rocks, they can withstand strong seas.

4. (a) ______________ and (b) ______________ are called cephalopods or "head-foot" animals because these two parts have become joined. (c) ______________ have eight arms, but (d) ______________ have ten. Although these animals do not have a hard, outer shell, both belong to the large group called (e) ______________.

7E

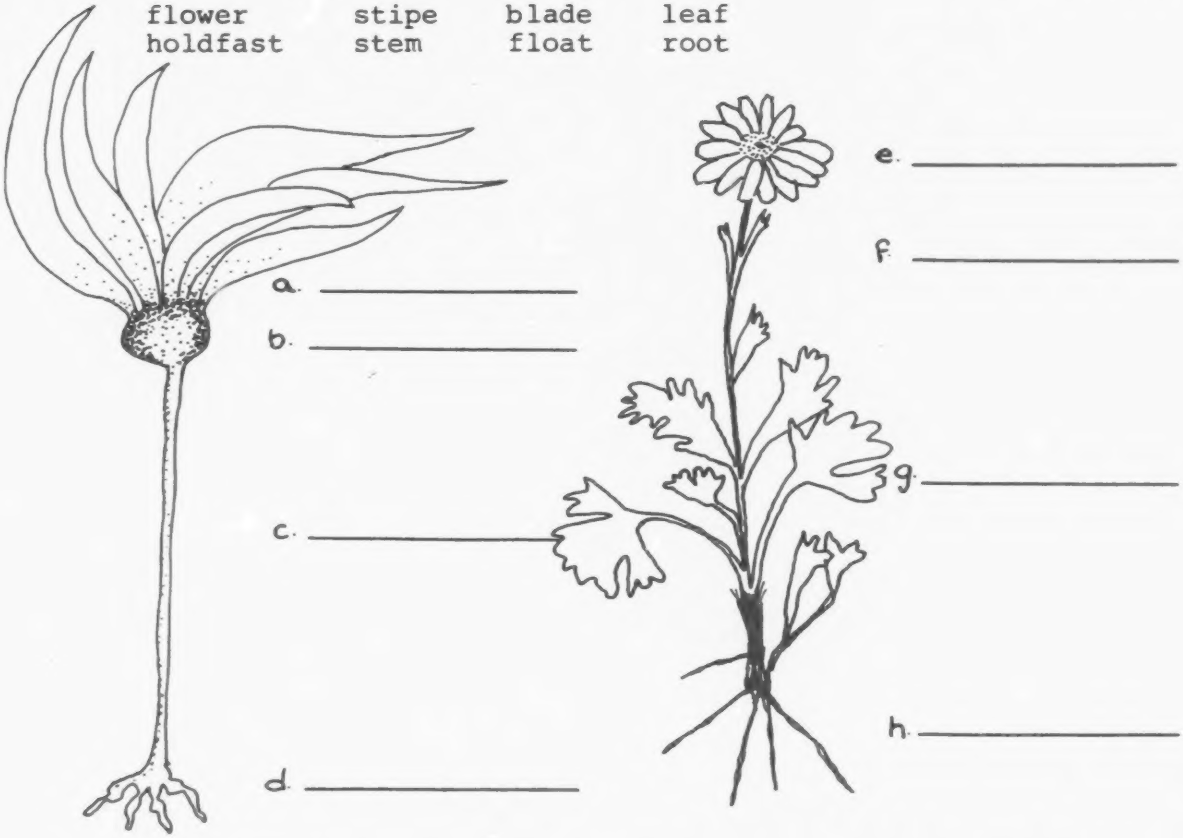
Seaweed

1. The three different types of seaweed are ______________, ______________, and ______________. (Hint: Think color!)

2. Another name for seaweed is ______________. (Hint: It starts with an "A".)

3. Label the parts of the seaweed and land plant illustrated below. Use this word bank:

flower	stipe	blade	leaf
holdfast	stem	float	root



4. Two ways that seaweeds are similar to land plants are that they ______________________ and ______________________.

5. Two ways that seaweeds are different from land plants are that they ____________________ and ____________________.

6. In Alaska, seaweeds are most common in which of the four seasons? ____________________ and ____________________

because ____.

Intertidal Zonations

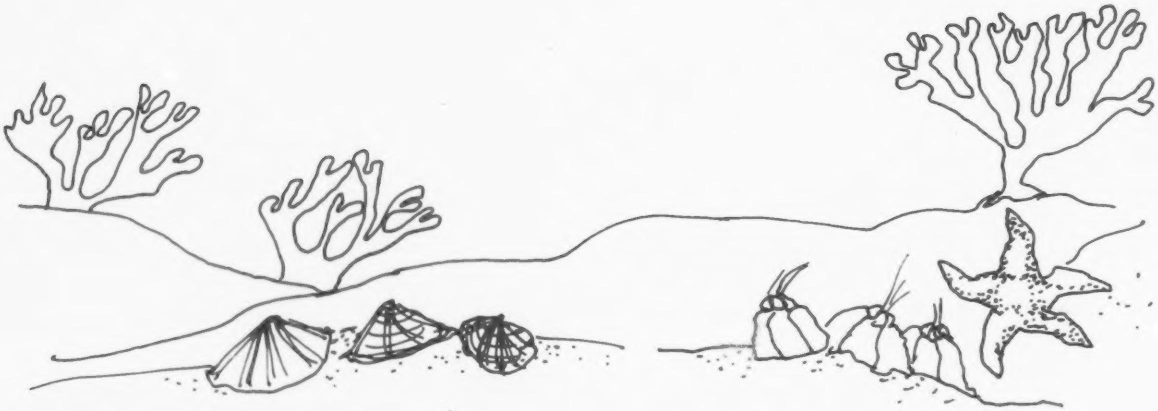
Intertidal animals and plants have to be very hardy to survive exposure to air, fresh water (rain and snow), summertime warmth and dryness, wintertime freezing temperatures, and predators from both the land and the sea. On the outer coast, they have to be able to hang on in pounding surf. Even in the more protected bays and inlets, fierce storms and waves occasionally flare up. But there are benefits, too--the tide brings a fresh supply of rich food and nutrients twice a day. And each of the predators can reach them only at certain tidal stages--so there are periods of rest and recovery. Also, these tough intertidal conditions make it difficult for some species to compete for food and space. Each species of marine plant and animal has a particular tolerance to the hazards of being out of salt water. By looking at the beach in a section from its highest high water mark down to the water level of a low, low tide, you can quickly begin to see major differences in plant and animal populations.

The Highest Fringe

At the upper limits of the intertidal zone, the fewest life forms are evident. You may notice that the rocks appear black here. This is because they are covered by a black encrusting lichen or by a blue-green alga that makes the rocks treacherous and slippery when wet. In these upper reaches, too, may be found the common tiny periwinkle--a fat, ridged snail that sometimes seems to pepper the rocks.

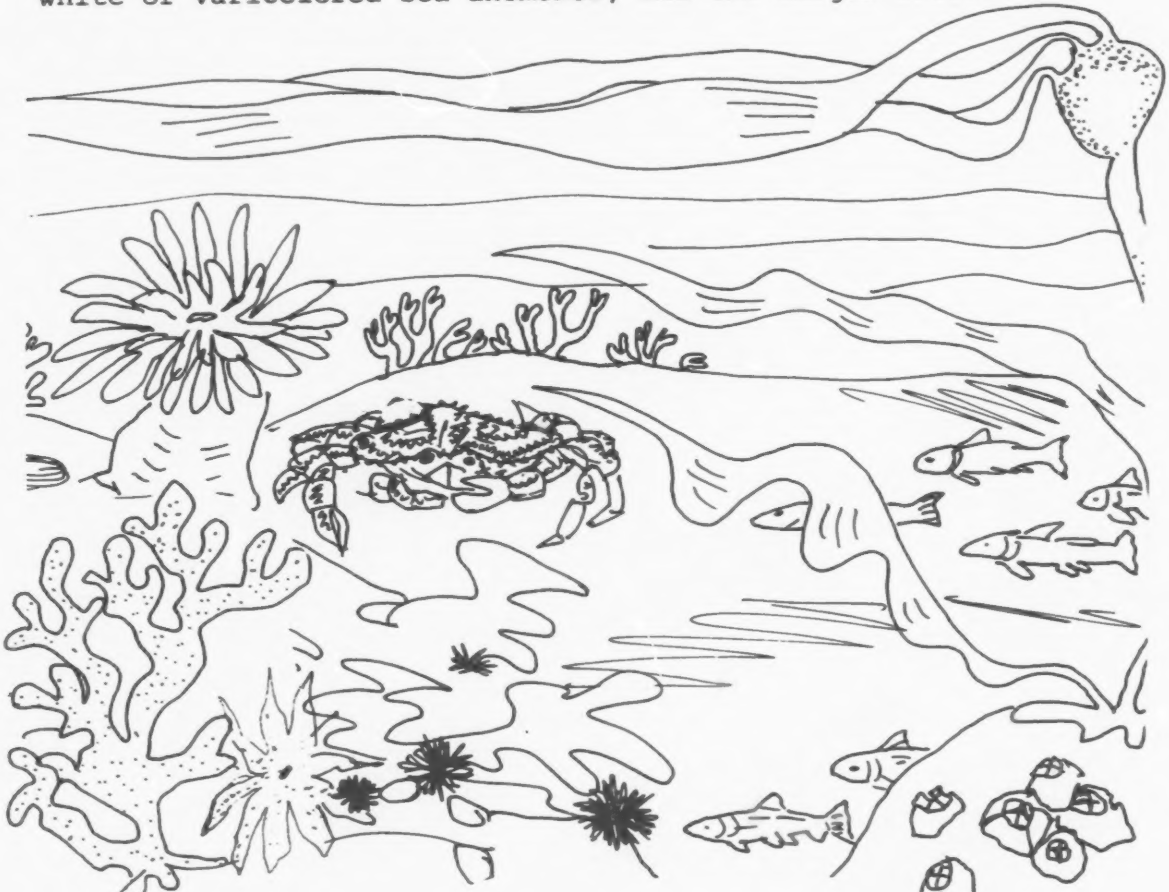
The Middle Zone

As you move toward the water's edge at low tide, you will be aware of obvious color bands or patches on the beach. There may be banding of Fucus, the common brown rockweed, and of blue-black mussels (the intertidal and subtidal bivalves that attach themselves by tiny threads to rocks, pilings and other surfaces), and barnacles. Here too, you will begin to see limpets, amphipods, various sea stars, tiny black sea cucumbers, and other forms of life not in evidence at higher levels.



The Lowest Zone

Approaching the water's edge, you will not find some of the plants and animals evident at higher levels. In general, however, the lower you go in the intertidal zone, the greater the diversity of life forms. Here you will find sea urchins, a wide variety of large sea stars, perhaps juvenile king crabs, large white or varicolored sea anemones, and the larger snails.



So...as you look at any particular beach for the first time, there is a great deal to think about. Remember that the location on the beach, the type of surface, the height from the water, and the kind of topographical variation all make a difference in what life forms may be found. In general, it is advisable to spend the lowest part of the tidal cycle closest to the water's edge, the area of the beach that is revealed to us least often, and which tends to harbor the greatest diversity of plants and animals.

Answer these questions:

1. What are five reasons why is it difficult for marine plants and animals to live in the intertidal zone?

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

2. What are two life forms you could find at the upper limits of the intertidal zone?

   a. ____

   b. ____

3. What are six life forms you could see in the middle zone?

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

   f. ____

4. What five marine life forms could you see at the lowest zone?

   a. ____

   b. ____

   c. ____

d. ______________________________

e. ______________________________

5. Make up a riddle about your favorite intertidal creature.

Here is a sample riddle (yours can be shorter).

Sometimes red
and sometimes green
when the tide is high
I'm seldom seen.

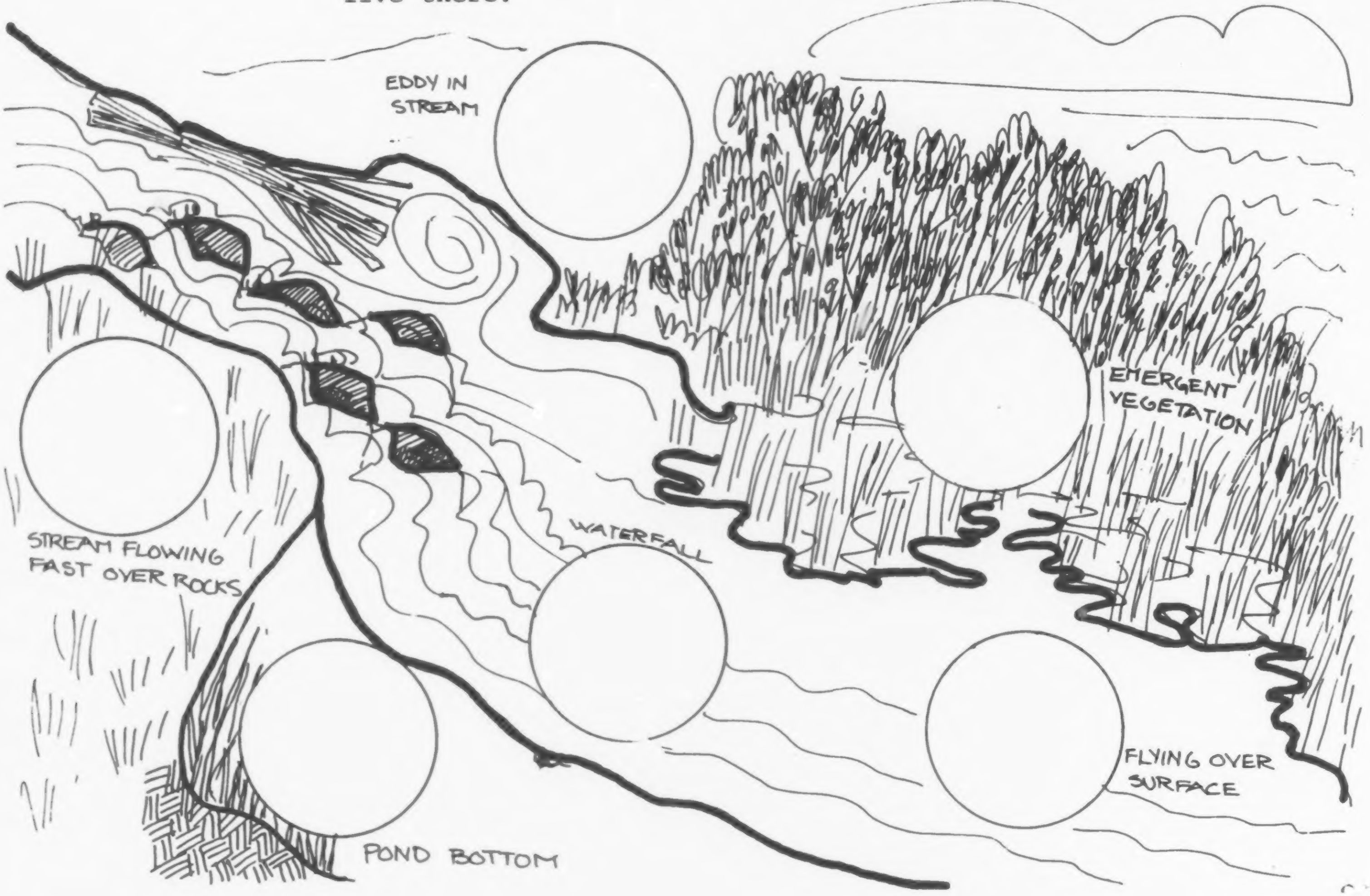
Tiny plants
I like to eat
I move them towards my mouth
with tube feet.

Find my round shell
on the seashore
but my many spines
aren't there anymore.

Who am I?

by Karen Stomberg

Draw a picture of an actual insect or crustacean which lives in the spot indicated or invent an animal that has adaptations (characteristics which help it survive) that would allow it to live there.


EDDY IN STREAM
EMERGENT VEGETATION
STREAM FLOWING FAST OVER ROCKS
WATERFALL
FLYING OVER SURFACE
POND BOTTOM

7H

Birds

Directions: Answer the following questions. Use bird reference books to help you.

What are six groups of birds that can be found in Alaska?

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

7. Give reasons why these birds are concentrated along Alaska's seas, rivers and wetlands.

____

____

____

____

____

8. How might changes that humans make to the seas, rivers and wetlands affect the kinds and number of birds?

____

____

____

____

____

____

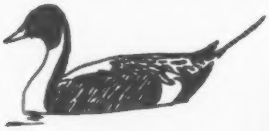
____

____

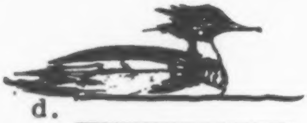
____

Birds in the Field

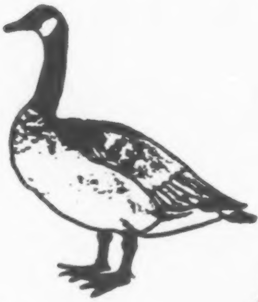
Use a bird field guide and write the name of each bird under the illustrations.



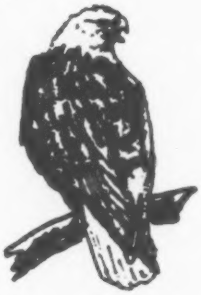
b. ____________________



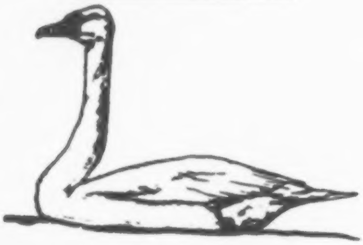
d. ____________________



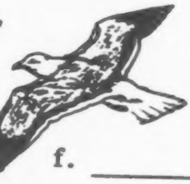
a. ____________________



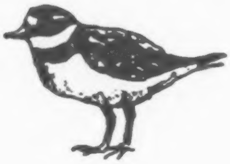
c. ____________________



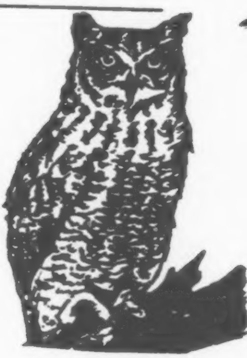
e. ____________________



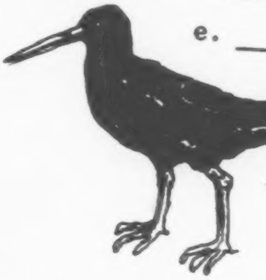
f. ____________________



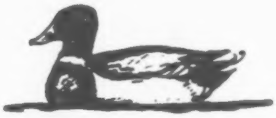
g. ____________________



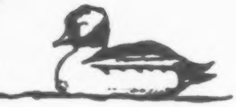
h. ____________________



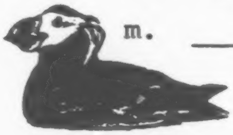
i. ____________________

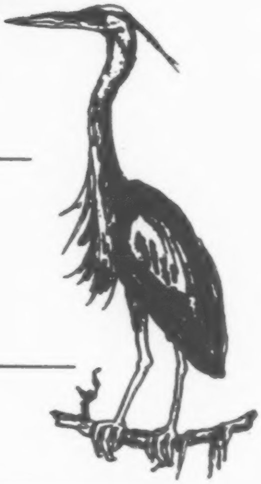


j. ____________________

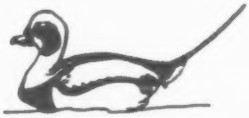


m. ____________________

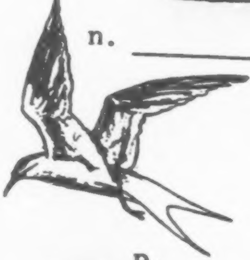




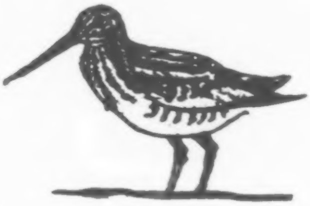
l. ____________________



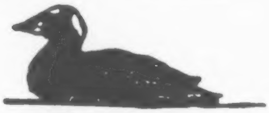
k. ____________________



n. ____________________

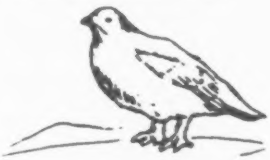


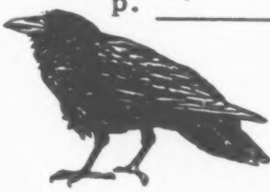
p. ____________________

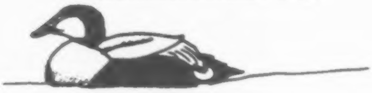


q. ____________________

o. ____________________







r. ____________________

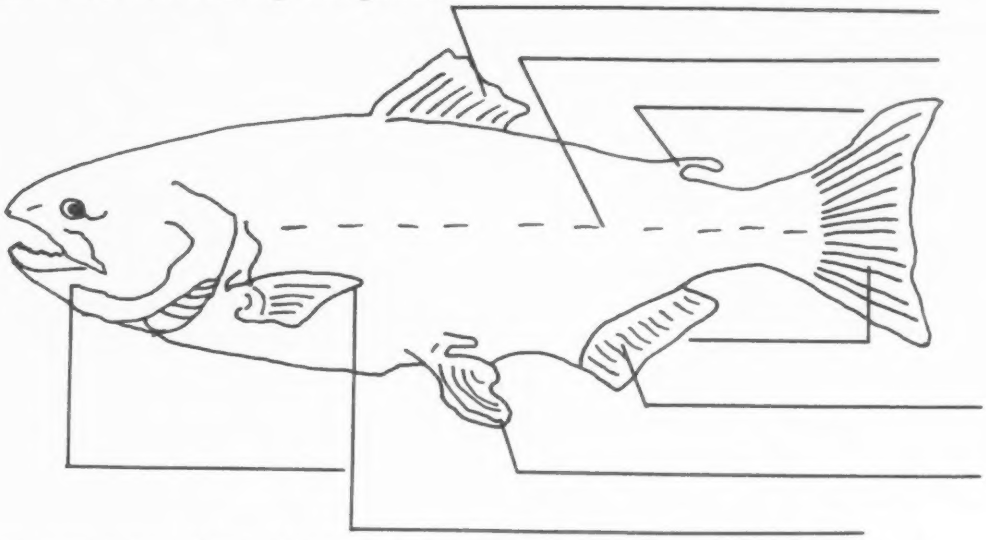
s. ____________________

t. ____________________

7J

Fish

1. Label the following diagram.



2. What are the five kinds of salmon found in Alaska waters?

____

____

____

____

____

3. Draw simple pictures with labels showing the four stages of a salmon's life cycle.

4. Why are wetlands important for salmon? ________________

____

____

____

5. Name five freshwater fish and tell something interesting about each one.

a. ____

b. ____

c. ____

d. ____

e. ____

6. Why are halibut called masters of camouflage?

____

7. List four ways that halibut can escape from predators.

a. ____

b. ____

c. ____

d. ____

8. Draw a picture showing how herring fit into the ocean's food web.

7K

Fisheries

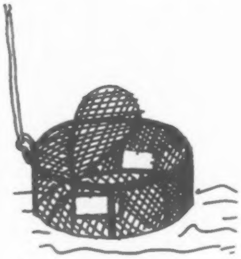
1. List three traditional fishing methods that are still used today.

   a. ____

   b. ____

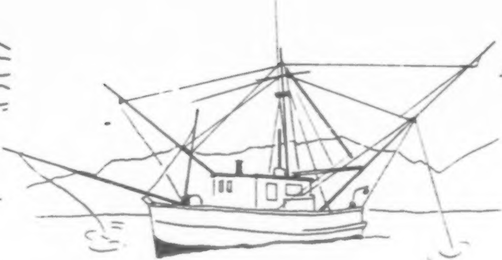
   c. ____

2. What are each of these fishing methods? What is being caught by each?



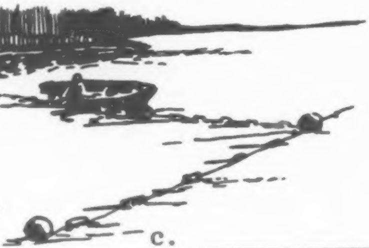
a. __

catches________



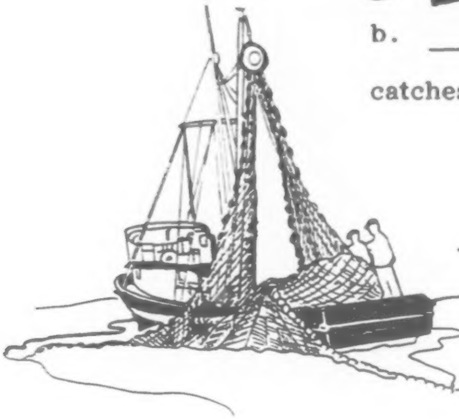
b. __________

catches__________



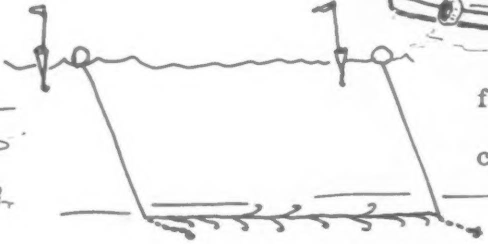
c. __________

catches__________



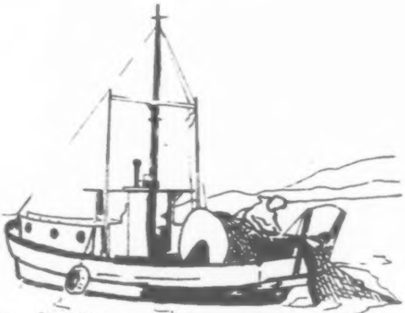
d. __________

catches__________



e. __________

catches__________



f. __________

catches__________

3. What are some ways of assuring that there will always be fish to harvest?

____

____

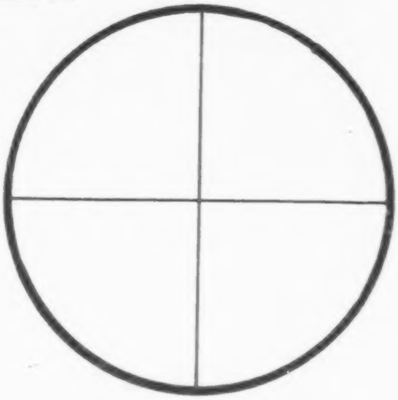
____

Marine Mammals

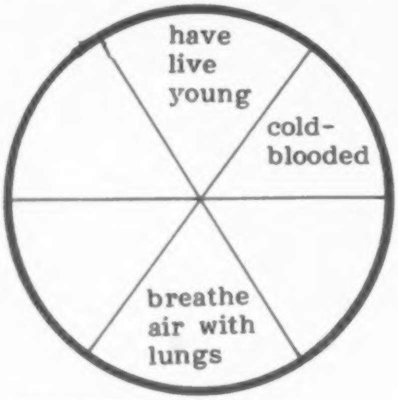
7L

1. Group the following animals into four groups by writing each name in one of the sections of the chart.

dolphin
whale
porpoise
seal
manatee
sea otter
sea lion
walrus



2. Block out the area that is not a trait of mammals and fill in the blank areas with additional traits.



Mark these sentences true or false.

________ 3. Marine mammals are descended from land mammals.

________ 4. Manatees are plant eaters.

________ 5. The worst enemy of whales is the killer whale.

________ 6. Whales and dolphins have very poor hearing.

________ 7. All whales have teeth.

________ 8. The largest animal that ever lived on earth is the brontosaurus.

________ 9. Large size is a disadvantage to life in cold water.

________ 10. Whales are considered to be of average intelligence.

11 and 12. What are two ways a land mammal would have to change in order to survive in the ocean?

13. Explain what echolocation is and how it is used by some marine mammals.

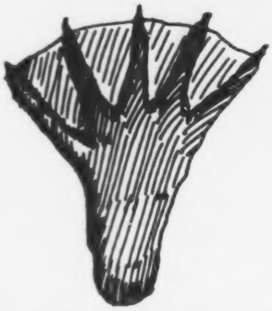
14. Describe a marine mammal in five different ways without naming it.

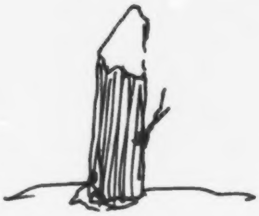
Now see if your friends can guess what it is.

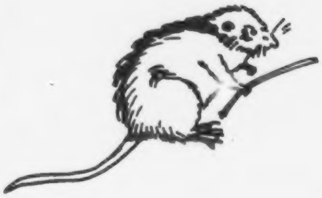
Freshwater Mammals

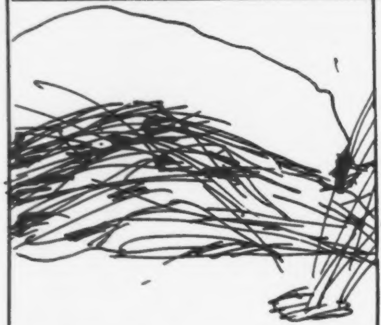
7M

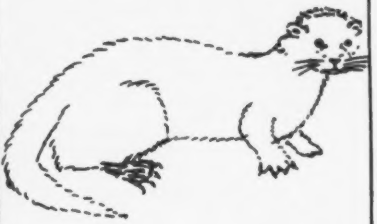
Here are four freshwater mammals, their tracks and some signs of their activity as seen in winter. Cut out the squares and match the ones that go together. Hint: there may be more than one sign for some animals.

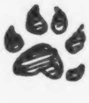


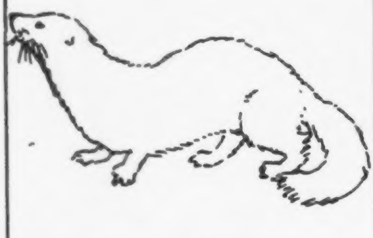


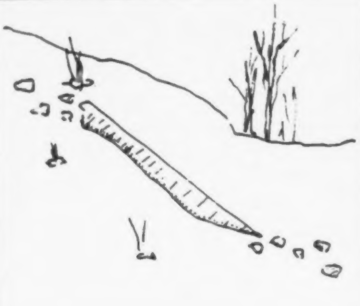


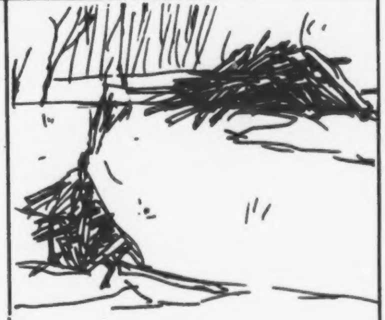


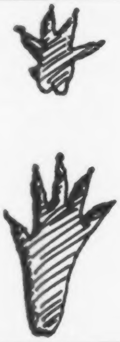


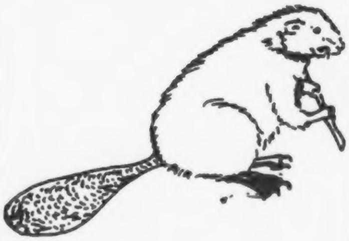


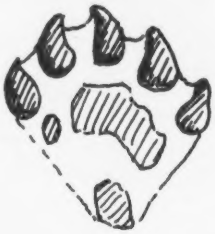












7N

Glaciers and Sea Ice

Fill in the blanks. Use these words:

rocks
blue
motion
snow
gray
black
silt
ice
leads

1. Glaciers are rivers of _______________.

2. Glaciers are formed when, year after year, more _______________ falls in winter than melts away in summer.

3. Glaciers gather up _______________ and earth from the land they cross.

4. Glaciers grind up rocks to make "glacial four" or _______________, which has many nutrients for marine life.

5. Sea ice is dangerous because of its constant _______________.

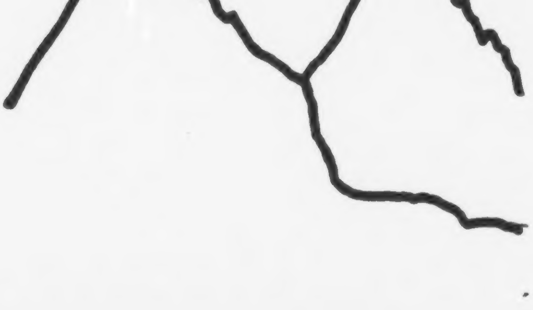
6. Large cracks that open up in sea ice are called _______________.

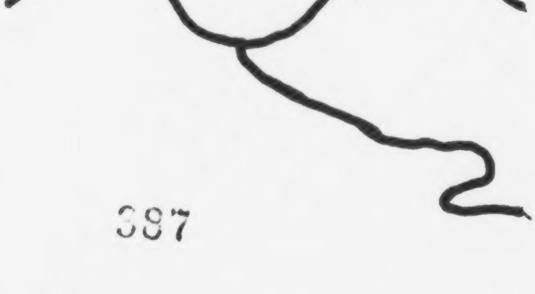
7. Unsafe, young sea ice is usually _______________ in color.

8. As sea ice thickens, it rises higher in the water and is _______________ in color.

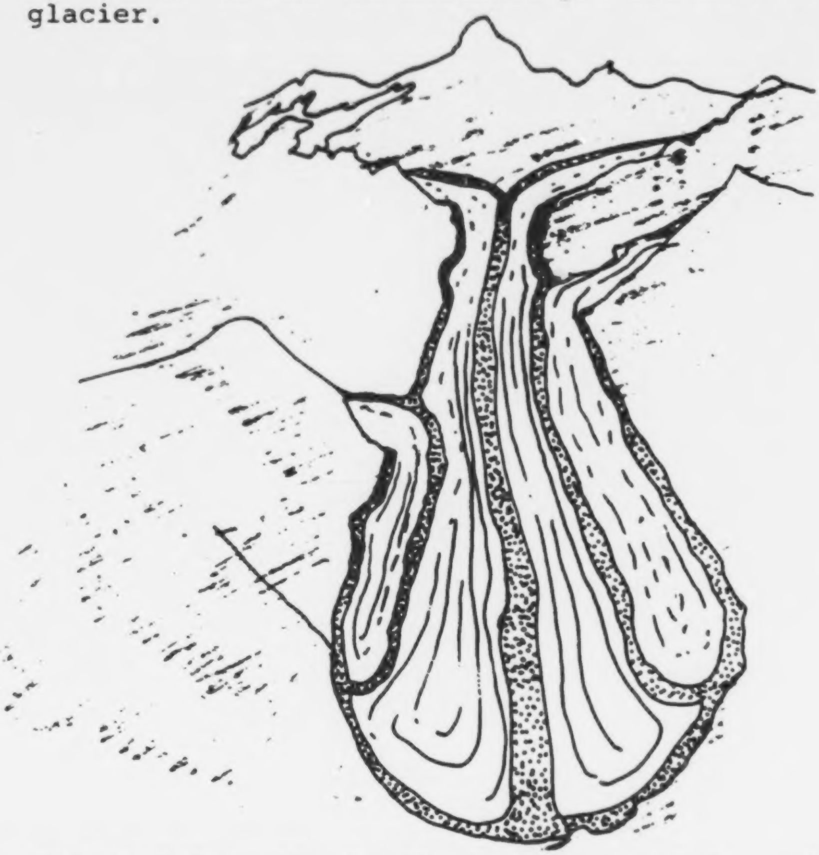
9. Both glacial ice and old sea ice are _______________ in color.

10. Put an "x" next to the valley carved by a glacier.

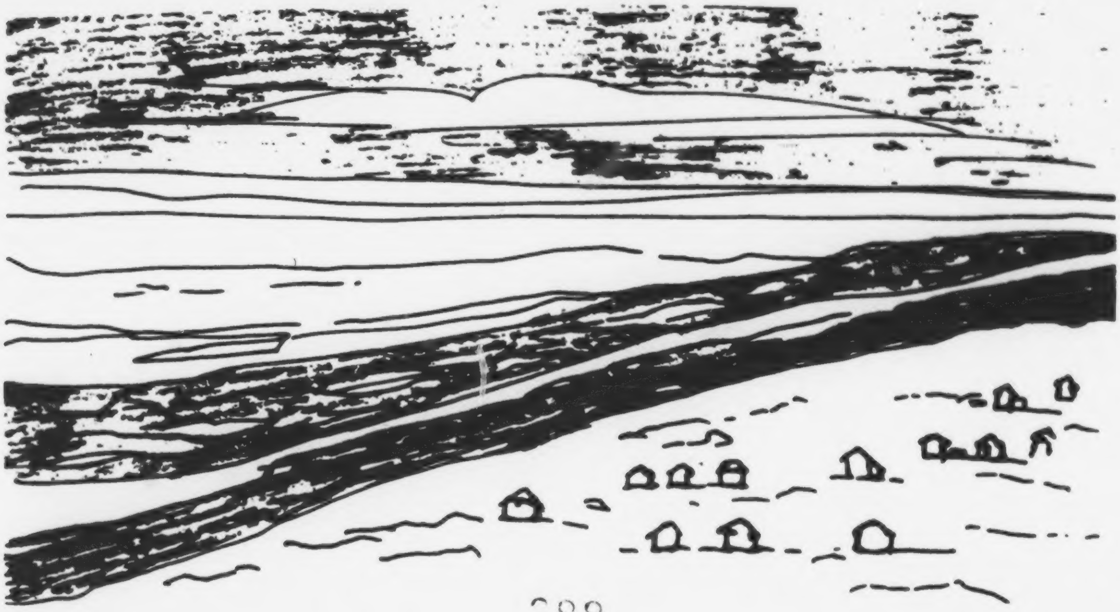




11. Put an "x" on all the moraines you see in this drawing of a glacier.



12. Put an "x" on the landfast ice and a "y" on the pack ice.



7N

Circle the word that makes the statement true.

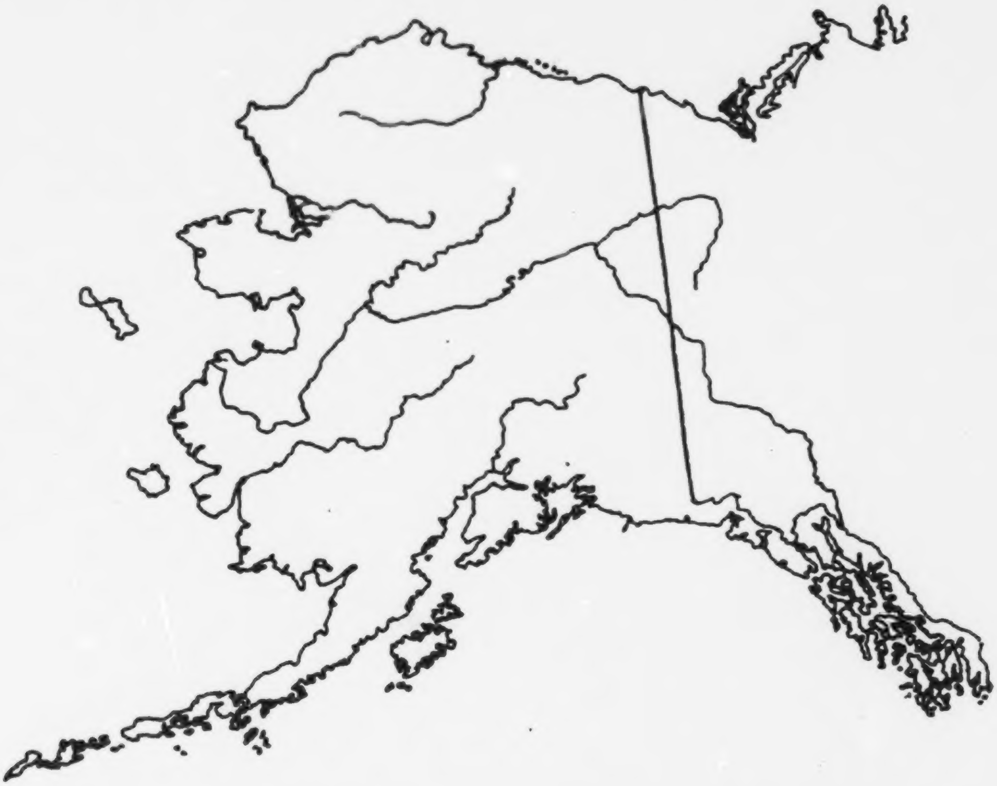
13. It's best to go out on the pack ice to look for polar bears when the wind and currents are blowing and moving (offshore, onshore).

14. Fish, invertebrates and mammals are (sparse, abundant) beneath the sea ice.

15. Young sea ice is usually (flexible, brittle).

16. Compare glacial ice and sea ice. Mention four ways they are similar and four ways they are different.

Native Uses of the Seas and Rivers



1 - 6. Write the names of nine Native groups on the map above, showing their traditional areas.

7. Describe one of the Native groups in your area.

They are called _ ______________________.

How did they use the seas and rivers traditionally? _______

Now? ____

In times long ago, they lived in _____________________________
and hunted with _______________________________.

They used _____________________ for transportation on the seas and rivers.

One word in their language is _______________________________.
It means ________________________.

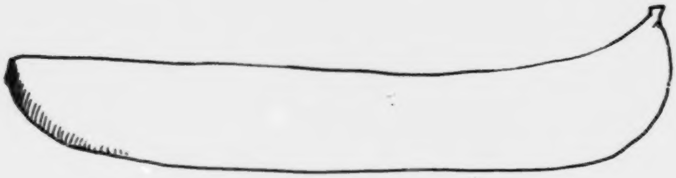
8. Compare the ways two of Alaska's Native groups, ____________ and ________________ depend on the seas and rivers.

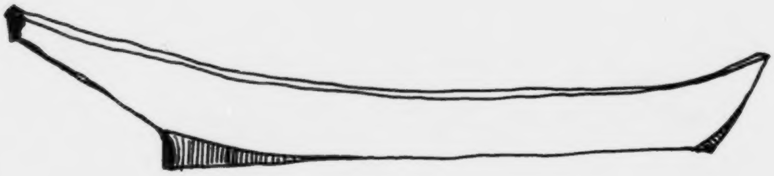
Five similarities are:

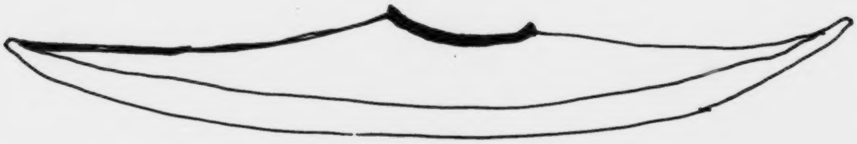
Five differences are:

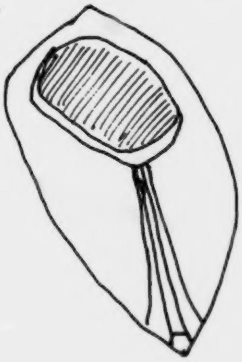
9. Describe life in your community 100 years ago through the eyes of a student your age. Tell why the sea and/or river is important to you.

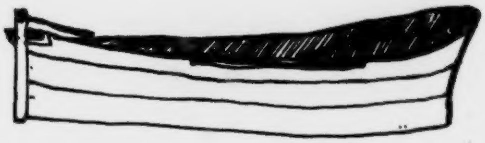
10. Below each drawing write the name of the boat and where it was used (northern, western, central, southwest, south-central or southeast Alaska).







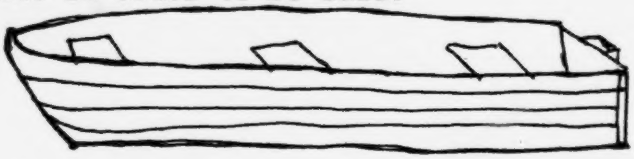


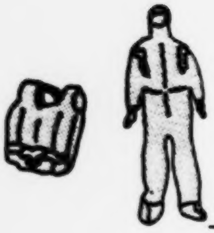


7P

Safety and Survival

1. Equip your skiff for a day-long fishing trip. What do you need to take in order to be safe?





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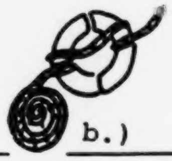

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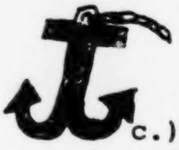

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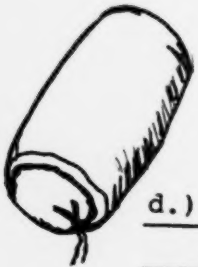

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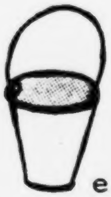

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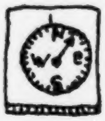

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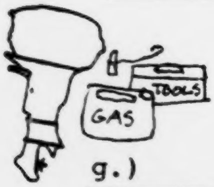

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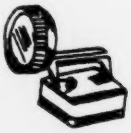

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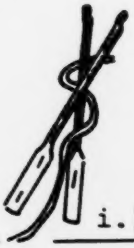

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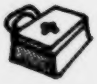

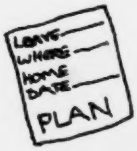
LEAVE
WHERE
HOME
DATE
PLAN

j.) ____________________

k.) ____________________

2. On your fishing trip, you spot some children on the shore waving wildly, so you head over right away. One of them shouts, "Johnny fell in the river. We just dragged him out and he's not breathing!" Describe what you would do, in detail.

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3. On your way down river after a good day of fishing, you hit a sweeper (log) and your boat breaks up and sinks. You are desperately hanging on to the log with your survival gear. Number the following steps in the order you would take them.

___ a. Take your lighter out of your pocket and start a fire.

___ b. Have your orange life jacket ready to wave; a mirror ready to shine; and green spruce boughs to put on your fire if you see a boat or plane.

___ c. Collect firewood, little twigs, and birch bark.

___ d. Get your fishing line and lure out of your survival gear and catch a fish.

___ e. Settle down for a comfortable night with your sleeping bag and tarp--thankfully remembering that you told your dad where you were going!

___ f. Put your clothes back on, putting your wool shirt next to your skin.

___ g. Make a shelter out of spruce boughs and an old log.

___ h. Carefully crawl along the log to shore.

___ i. Take off your clothes and wring them out.

___ j. Eat a little of your survival food for some quick energy.

___ k. Jump up and down to warm up.

___ l. Set some snowshoe hare snares with the wire in your survival gear.

___ m. Roast your fish over the fire along with your spruce tea.

___ n. Try to dry your clothes over the fire.

4. Now describe what you would do in a survival situation if you had only what was available in your pockets!

My pocket contents are: ______________________________

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I would ____

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Putting on Your PFD

8A

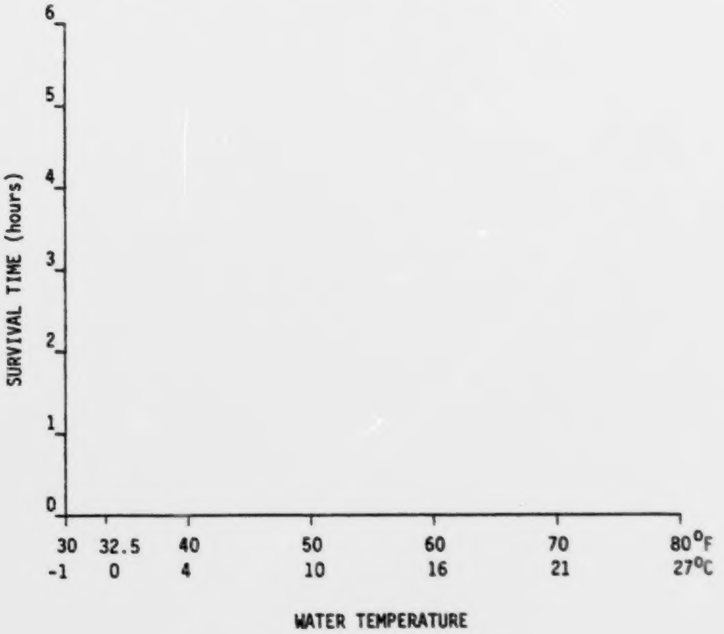
If you fall in the water, you can easily protect yourself from drowning by wearing a personal flotation device, or PFD. But protecting yourself from impending hypothermia is not so easy. "Hypothermia" means lowered or subnormal deep-body temperature. If you fall in the water most anywhere in Alaska, your body starts chilling rapidly. You will start shivering intensely in an attempt to increase your body's heat production. If the condition is allowed to progress, you will become unconscious and eventually die, either by drowning or from hypothermia.

Hypothermia can easily strike on land, too, especially if you are caught in the rain or cold without raingear or warm clothes. In any event, whether you are on land or sea, even a slight increase in survival time could mean the difference between being dead or alive when rescuers arrive.

1. Based on this chart, graph the results of hypothermia at various water temperatures for people not wearing life jackets.

Survival Times without Life Jackets

Water Temperature (°F)	Exhaustion or Unconsciousness	Survival Time
32.5	Less than 15 min.	Less than 15 to 45 min.
32-40	15-30 min.	30-90 min.
40-50	30-60 min.	1-3 h.
50-60	1-2 h.	1-6 h.
60-70	2-7 h.	2-40 h.
70-80	3-12 h.	3 h. to indefinite
Over 80	indefinite	indefinite



2. What is your local water temperature? ____________________

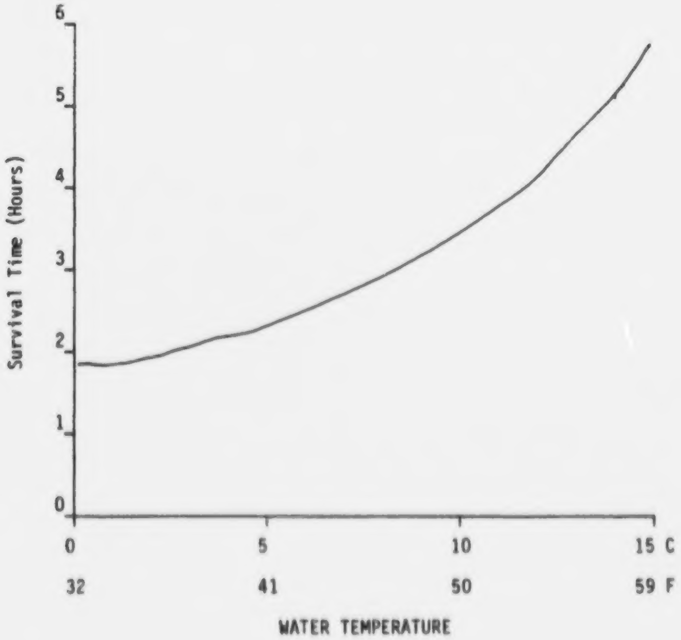
3. How long would you survive at that temperature according to the chart? ________________________________

(Hint: These chart figures are for normal adults. People with more fat would last longer, and smaller people would have shorter expected survival times. Because of smaller body mass and relatively little fat, children cool much faster than adults.)

4. Here is a graph of average predicted survival times of normal adults wearing a standard life jacket and light clothing and holding still.

   a. How much would wearing life jackets increase adult survival time in your area? ________________________

   b. Predict your increased survival time. _______________



5. To conserve body heat in cold water, don't swim. Your body will produce three times the heat when swimming, but that heat is all lost to the cold water. The average person swimming in a life jacket cools 35 percent faster than when remaining still. Use your estimate in question 4b and figure out what your survival time would be if you swam in your life jacket. __________

6. Tests conducted on adults swimming in 50°F ocean water with standard life jackets and light clothing showed that the average person can cover only .85 mile before being incapacitated by hypothermia. Remember also that it is difficult to judge distances in rough, cold water. The distance a person can swim is affected by his swimming ability, the amount of insulation, and water conditions. Estimate the maximum distance you could swim in your local waters with a life jacket. _______________ (Don't forget it is almost always best to stay with your boat. Not only do you lose lots of body heat by swimming but staying by a boat--even an upside-down or broken boat--makes it easier for rescuers to spot you.)

7. If you are in the unfortunate situation of not having a life jacket or anything to hang onto, you will be forced to tread water or try drownproofing. Treading water involves continuous movement of arms and legs in various patterns to keep the head out of the water. By treading water, people cool off 34 percent faster than in a life jacket holding still.

   Drownproofing involves restful floating with lungs full of air, interrupted every 10 to 15 seconds by raising the head out of the water to breathe. Even non-swimmers can thus avoid drowning for many hours. Unfortunately, in cold water (50°F) drownproofing results in a cooling rate 82 percent faster than when holding still in a life jacket! This is mostly due to putting the head (a high heat loss area) into the water. So keep your head out of the water! Tell in your own words why wearing a PFD is important.

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8. Large amounts of heat are lost not only from the head but also from the sides of the chest (where there is little muscle or fat) and the groin (where large blood and lymph vessels are near the surface). So, to conserve heat, assume HELP (the Heat Escape Lessening Posture). Your PFD will help you hold your head out of water. Tuck the inner side of your arms against your chest. Press your thighs together and raise them to close off the groin region. This body

position will increase your survival time by 50 percent. Take your predicted survival time in 4b and increase it by 50 percent. My survival time if I use HELP is __________ . Practice HELP in your seat until you can do it automatically. Then practice it in the water.

If there are several people in the water, buddy together to help conserve heat. And keep a positive attitude. Don't panic.

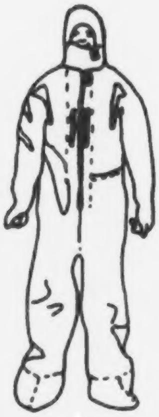
9. Different styles of PFDs offer different amounts of thermal protection. Label the pictures with poor, fair, good or excellent after you read the descriptions.

Poor - All loose-fitting PFDs and float cushions offer no significant protection from the water.

Fair - Foam vests and float coats that possess good adjustability for close fit to the chest increase survival time 50-70 percent.

Good - Float coat (with closed-cell, foam-rubber beaver tails that snap up and over your groin) and float coveralls increase survival time more than 2½ times as long as a standard PFD.

Excellent - Survival suits cover everything except your face with closed-cell foam rubber. These suits are designed to be worn in rough weather or when you are in danger. Other than a raft, they are the best survival gear available. In contrast, the PFDs mentioned above are designed to be worn continually when you are around water.



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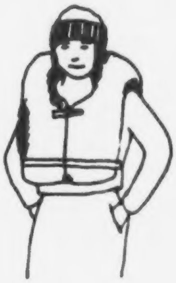

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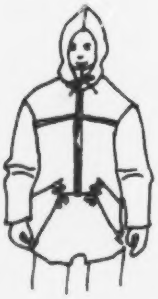

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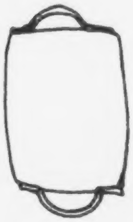

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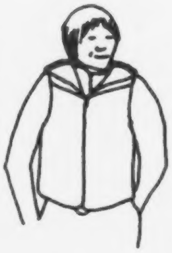

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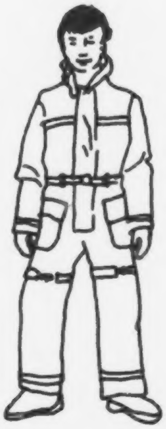


f.

10. When you are purchasing a PFD, find out which ones will hold your head out of the water even if you are unconscious. Check the costs of each of the above-mentioned types of PFDs in local stores or catalogs, and write the prices next to the pictures. Now describe which one you would like to buy, how you'll get the money, where you'll buy the PFD, and what you'll use it for.

As soon as you buy it, stick some survival gear (flares, lighter, fish lines, hook, knife, light, etc.) in a pocket or sew it in the lining. And don't forget to wear your PFD! It doesn't do you much good if it's in the boat and you're in the water.

Water Safety Cartoons

Directions: Draw cartoons to illustrate these statements.

Keep a survival suit handy and know how to use it.	Watch the weather for storms.
Always leave word of where you're going and when you'll be back.	Use lights when boating at night.
Keep track of the tide.	No fooling around in any boat.
Always wear a PFD.	Have tools, spare parts, extra gas, spare motors and oars along with you.
Step carefully into the center of a small boat and keep your center of gravity low.	Anchor your boat securely.
Don't overload the boat.	Watch for rocks, logs and debris in the water.
Avoid sharp turns in a small boat.	Don't drink alcohol or take drugs around the water.
Don't lean out or stand up in small boats.	Always carry survival gear in your boat.
If your boat capsizes, stay with it.	Know how to use a life raft.

How to Survive On a Beach

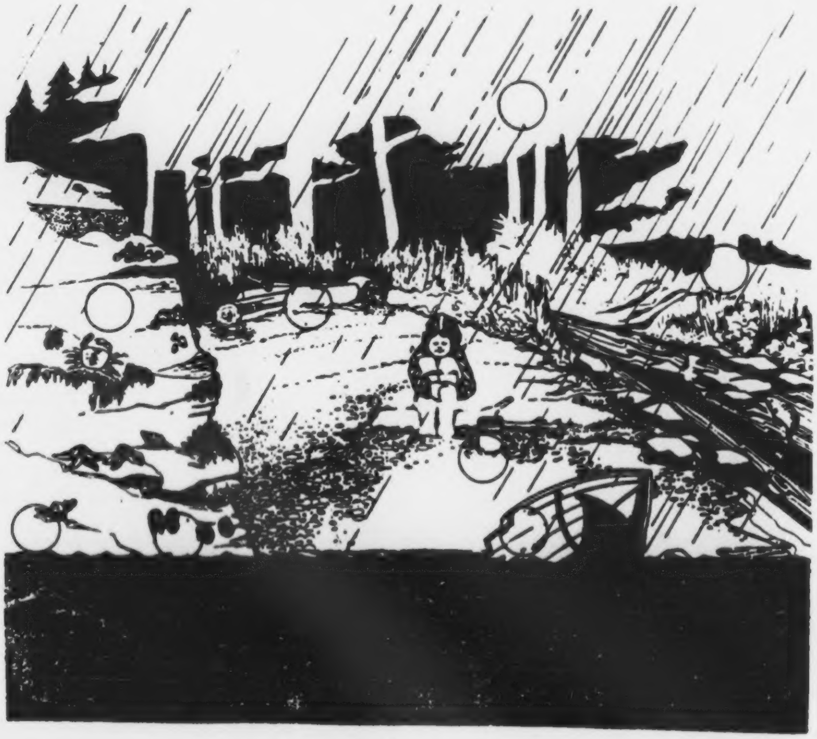
"HOW TO SURVIVE ON A BEACH" is excerpted and adapted from Alaska Tidelines, Volume II, Number 8, May 1980. Published by the University of Alaska Sea Grant College Program, Copyright © 1980. Reprinted by permission.

You made it to shore. But it's the wrong shore--one of Alaska's thousands of uninhabited islands. Your boat's wrecked. Rain is pouring down. You're cold, wet and hungry. And since nobody knows where you landed, it looks as if you'll be here for awhile.

Well, don't just sit there. You're on your own now, and you must help yourself until other help arrives. Obviously, your basic needs are going to be:

1. Shelter and warmth.
2. Drinking water.
3. Food.

So take stock. Look around. Identify what you can use to fill each of these needs by writing its number in the circles on this picture. Now is the time that Basic Survival Kit you always carry will really come into its own. And if you follow the rules for outdoor survival, you'll come through in good shape.



The word "survival" has a special meaning in a land like Alaska where the wilderness usually begins at the outskirts of town, and empty beaches may stretch for hundreds of miles on either side of your community.

Say your outboard conks out in the middle of a severe squall while you are fishing. Or you didn't figure the tides right, and find you are no match for the outgoing current. Suddenly, just a few miles from home, you are faced with a survival situation.

What do you do?

FIRST THINGS FIRST

Take shelter under the trees from the wind and rain. Get out of those wet clothes, wring them out and put them back on again. If you are very cold, gather long grass and stuff it inside your clothes to act as insulation. Move around until you warm up.

The next step is inventory. Take a critical look around, taking stock of things that can either help or hurt you.

Sit down and relax. Save your energy and body heat. Now is a good time to go through your Basic Survival Kit and check out what you have. Then plan how you will deal with those three basic needs in the order of their importance.

SHELTER AND WARMTH

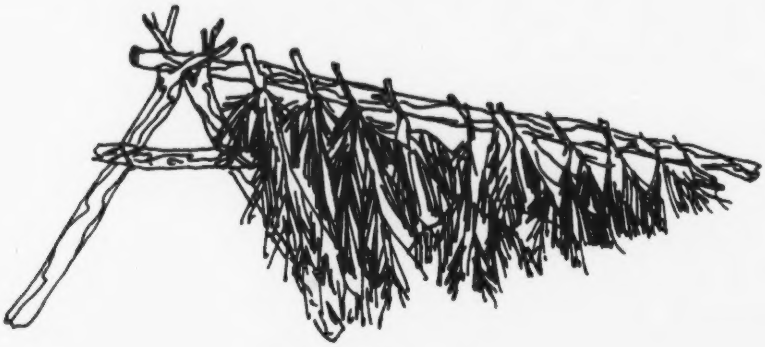
The first thing you need is a camp. Stay near the beach where you can be found. Don't start off on any long cross-country trips that will just wear you out.

CAMPSITE: Choose a campsite close to your food and water supply. Your best source of fresh water is a stream or spring flowing down across the beach. If it is a river and the salmon are running, you'll have plenty of food. But don't camp too close if you're in bear country. So far as beach food is concerned, shellfish are most abundant in areas where there is a mixture of gravel, big rocks and tidepools.

Look for a flat spot at the edge of the beach, well above the high tide line, where grass and weeds will give you a good insulating ground cover. (Beach sand or gravel is apt to be damp.) Camp under trees or in an area where there is good protection from the wind. If the site faces south, you'll get more sunlight to dry out your camp after a rain.

SHELTER: Rig up the plastic sheet from your survival kit between three or four trees to serve as a "rainfly" over your campsite. Keep it high enough so that you'll have some room to move around in.

Cut branches to build a small shelter to sleep in. Keep it as small as possible--just a little larger than you are--so that your body heat will warm it. Use evergreen boughs, leafy boughs, or long dry grass (dig down under the wet stuff) for both mattress and bed coverings. (Of course, what's left of your boat, turned upside down, will provide good shelter, too.)



FIREWOOD: Gather a good supply of firewood and pile it where it will dry. Avoid picking up wood from the ground because it is almost always wet. Instead, collect dead twigs or branches from trees or bushes. Standing dead trees are best. Newly fallen trees are good, too, since they still have enough sap to burn readily. If the bark is wet, peel it down to the dry wood inside. Spruce kindles easily and burns fast. Alder lasts longer and leaves good coals. Drift logs with creosote (tar) on them burn especially well. Driftwood found on the beach is usually dry inside.

Small sticks and branches can be broken into suitable lengths across your knee. Thicker pieces can be broken by making deep cuts or notches on opposite sides of the branch with your knife, and then banging the piece sharply against a large rock or log. For a warm, slow-burning fire, use larger logs. Put one end into the fire and move the log up as it burns. Or start the fire in the middle, so that after it burns through you will have two logs that are easier to handle.

FIRE BUILDING: Dig a small fire pit on the beach close to the front of your shelter. Line it with flat rocks and back it with a large log, if possible, to act as a windbreak.

Place the smallest, driest twigs you have collected in a criss-cross pattern on the flat rock. (For a sure fire when the weather is wet, start off with a piece of the cotton from your survival kit.) Build small pieces of kindling up over this like a tepee. Be sure there is enough air between the twigs for the fire to start.

Check the wind direction. Then light a match and touch it down so that the flame blows into the center of your carefully arranged tinder. Let the fire burn for a minute, then gradually add larger pieces of wood as the flame builds up. Once it's going well, put on larger logs or driftwood to hold it, and pile wet wood around the sides to dry out.

Always keep your fire small, especially if it's under your rainfly. A small fire will provide all the heat you need, save you the hassle of gathering wood, and is best for cooking.

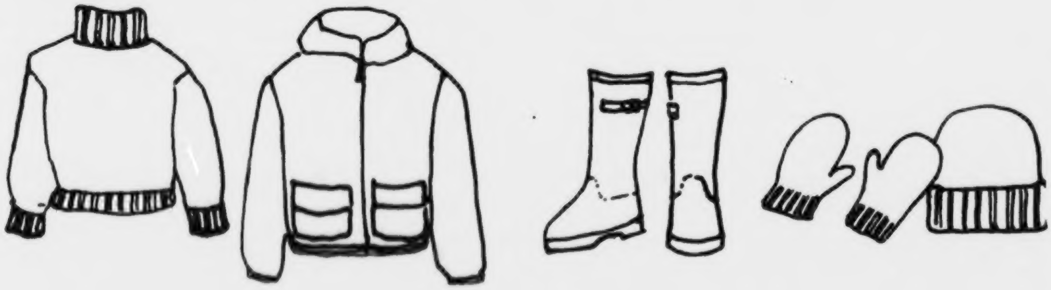
COOKING: Fish or shellfish can be wrapped in damp seaweed, skunk cabbage leaves, or foil, and cooked in the coals of the fire. And of course, there's the time-honored hot dog/marshmallow way of roasting food over the fire on a stick.

Heavy pots can be placed right in the fire, but if you're making do with the coffee can from your survival kit, it would be better to rig up a spit and hang it over the fire.

NOTE: You can't really prepare for a survival situation--because you can't know when you'll be in one. But here are some precautions you should take on any boat trip:

- Always let someone know where you are going and when you expect to be back.
- Federal law requires that every boat carry a personal flotation device (life preservers, called PFDs) for each person on board. For boats more than 16 feet long, these PFDs must be wearable. Wear yours.
- Loss of body heat--called hypothermia (HIGH-po-THER-me-uh)--can be as deadly in cold water as drowning. But with wet clothes in cold windy weather, hypothermia can also hit you on land or while you're still in the boat.

Dress to avoid it. In cold wet weather, wear rain gear and wool clothes. Wool keeps you warm and dry, because it resists moisture and insulates even when wet. Cotton soaks up moisture--so your cotton jeans just make you wetter and colder.



DRINKING WATER

Lack of fresh water is harder on your body than lack of food. The loss of body fluids greatly reduces your survival time. Avoid moving around or working so hard that you sweat. Drink as much water as possible--more than you really want. Hot water is especially good because it also helps keep your body warm.

A source of fresh water is of vital importance. Freshwater streams or springs can be found flowing across most beach areas. Your plastic sheet can be rigged to catch rain water--usually in plentiful supply around Alaska at this time of year.

In coastal areas where cliffs drop directly down into the sea, soaks or springs are sometimes found at the base of rock cracks or faults. These are usually marked by clusters of green ferns or mosses.

If worse comes to worst, you can convert salt water into fresh water by soaking up the steam from boiling sea water in a thick layer of cloth (your shirt, if necessary). Rig the cloth horizontally over a pot of boiling sea water. The salt stays in the pot, and when the cloth becomes saturated from the moisture in the steam, it can be wrung out into a container. It's a slow process, but it speeds up a bit when the cloth is wet after being wrung out the first time.

FOOD: TIME FOR DINNER

So it isn't hamburgers, fries and ice cream. But there's food on the beach that will keep you alive and in business almost indefinitely. Most of these foods have long been gathered and enjoyed by the Native people of Alaska's coastal areas--who claim that other people don't know what they're missing.

In survival situations, it is best to save your energy by starting out with the foods that are easiest to get. These foods can be found throughout the intertidal zone, clinging to rocks, hiding in shallow pools, or buried in sand and gravel only a foot or so below the surface of the beach. You just have to know where to look, and what you're looking for:

SNAILS: Many different species of snails are found on rocky beaches from the high tide mark on down; the larger ones live closest to the water's edge. All are edible, but watch out for the moon snail and Oregon triton, which eat clams and concentrate paralytic shellfish poison. Soak snails 3-4 hours in fresh water, then boil for 20 minutes or so, drain and cool, peel off the horny "trap door" at the opening, and pull out the white meaty muscle. (The intestines usually stay inside.)

LIMPETS: Shells look like small pointed Chinese coolie hats. Limpets are found in the high tide zone on rocks covered with a film of algae, on which they feed. Use your knife to pry them off, and cut out the white muscle meat on the underside. This can be eaten raw, simmered in water, or fried after pounding to tenderize it. Or if you find a flat rock loaded with limpets, do as the Native people sometimes do:

> Cover the rock with damp seaweed and lay hot stones from your fire on top. The limpets lose their hold on the rocks as they cook, and may be eaten on the spot (along with the cooked seaweed).

KEYHOLE LIMPETS: These are found farther down the beach and look very much like true limpets except for the small hole at the peak of their "hats." They are closely related to the delicious abalone which, unfortunately, is found out-of-reach in deeper waters. Keyhole limpets are cooked in the same way as true limpets.

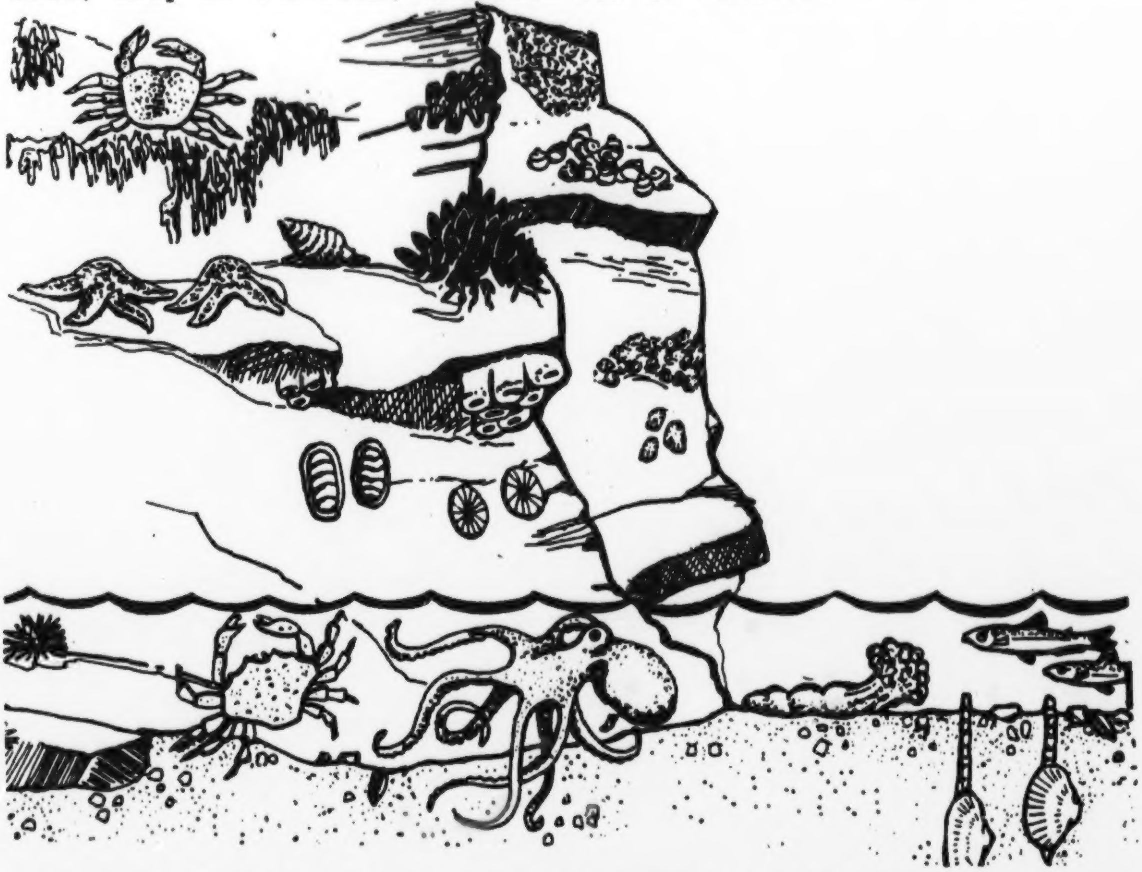
SEA URCHINS: Round spiny creatures that look like red, green or purple pincushions. They live on rocks or kelp in tide pools or shallow waters near the low tide mark. All sea urchins are edible. Their bright orange eggs are considered a delicacy and eaten raw. (Scoop out the eggs inside the shell with your finger.) Or you can throw the whole urchin into your campfire, cook it until the spines burn, then crack it open.

CHITONS: Chitons are oval-shaped creatures whose shells are made up of eight overlapping plates. They, too, fasten themselves tightly to rocks and must be pried loose. Chitons live in the middle to lower tidal areas and are often found on the underside of boulders or grazing in seaweed-covered rocks. The largest species are the Black Katy chiton and the gumboot chiton, which may reach a length of 10 inches or more. The big gumboot--so-called because of a tough, leathery reddish-brown covering which hides its plates--has long been a favorite food of southeast Alaska Indians. Cut out the smooth "foot" on the undersurface, scrape and wash. The meat may be eaten raw; or sliced, pounded with a rock to tenderize, and fried. Or the whole chiton can be roasted in the fire. But leave these creatures alone unless you are really starving, as they are becoming quite rare.

SEA CUCUMBERS: Another sea creature that is considered delicious--but doesn't look it. Actually, it resembles a very large, squishy, reddish-orange dill pickle. The sea cucumber usually lives in water below the low tide mark, but occasionally is found nestled between rocks or stranded on the beach. When relaxed, it may extend to its full length of a foot or more, but when disturbed it tenses up and becomes quite firm. And when extremely disturbed, it tries to startle and confuse its enemy (steady!) by expelling all its internal organs--intestines, the works--and then slipping away to grow a new set. But if it does that, you won't have to clean it. Slice off both ends and slit open the body. Remove the five long, white muscles just under the skin and discard the rest. Slice the muscle into pieces and fry quickly, or cook as for chowder. The meat is tender and tastes much like clam meat.

OCTOPUS: Check around a low, low tide for an octopus den, marked by a litter of empty crab shells and other debris in front of a small depression under a rock (see Tidelines, October 1979). Cleaned and sliced and pounded to tenderize, a young octopus will provide several good meals.

CRABS: Keep an eye out for Dungeness crabs in shallow bays, or dug into the sand when the tide is out (see Tidelines, February 1980). Crabs usually are cooked alive in boiling seawater. But if you're making do with that coffee can, you'll have to butcher it first by pulling off the back of its shell and breaking off the legs and claws. Clean off everything but the shell and body meat. Cook as soon as possible after cleaning. Bring water to a boil, drop in the crab, and boil for 15 minutes.



Directions: Label this drawing with the names of the animals and plants that you see.

WATCH OUT FOR THOSE FILTER-FEEDERS!

Clams and mussels are found in abundance on most of Alaska's gravel and rocky beaches. They are easy to gather and cook, delicious to eat, and are among the favorite standbys for survival food on the beach.

But there is a problem. Clams and mussels get their food by straining or filtering plankton from seawater. And sometimes they pick up a toxin (poison) from one of the dinoflagellates thought to be primarily responsible for the damaging "red tides."

This poison doesn't bother the clams or mussels, or the fish that feed upon them. But it is very dangerous to human beings and causes Paralytic Shellfish Poisoning (PSP), which can be fatal. It is doubly deadly because you can't smell it or taste it.

So before eating clams or mussels in quantity from a strange beach, check to be sure. Eat only the white portion of one clam (or the yellow portion of one mussel). Then wait an hour. If you feel any numbness or tingling in your tongue, lips or nose, don't eat any more. Stay away from all clams and mussels in the area. Each person should do this, as people have different levels of tolerance for the toxin.

The vast majority of Alaska's clams and mussels, however, are untainted and are very good indeed:

MUSSELS: Blue mussels are found clustered together, fastened to rocks in the high to mid-tide zone. Wash off the shells and remove the "byssal threads"--the silky filaments that they use to fasten themselves to objects. Roast or steam open, and eat from the shells with their juice.

CLAMS: Alaska has more than 160 different species of clams--butter clams, soft-shell clams, littlenecks, pinknecks--found in a mixture of sand, mud and gravel a foot or so below the surface of the beach. Dig where you see squirts of water coming up. Eat them raw or simmer as for chowder. For a real feast, build a fire in a pit with rocks at the bottom. After the fire burns out, load in clams and seaweed (any kind of seaweed), pour on some seawater, and let the clams steam until they open their shells.

HOOLIGANS, BLENNIES AND GRUNTS

These are all real fish that can be found on the beach--or caught from the beach--without getting your feet too wet. Don't let their names (or their looks) throw you off. Gutted, cleaned, wrapped in seaweed or foil and baked in the coals of your fire, they taste as good as any other fish.

HOOLIGANS (their correct name is "eulachon": also called "candle-fish"): Small, smelt-like fish that run in large schools near the beach in late spring. When a good run is going, you can rig up a net and scoop them up in the shallow waters off the beach.

BLENNIES (also called "pricklebacks"): Found under large rocks in the intertidal zone. They look like eels, but they're not. Their heads are small and pointed and a narrow dorsal fin runs the full length of their bodies, which range up to 11 inches.

GRUNTS (these are bullheads, also called "singing fish" because of a grunting, hissing sound that they sometimes make when removed from the water): These can be found under rocks and in tide pools, in late spring or early summer. They have wide heads with bulging eyes and a long, tapering body, dark on top and white beneath. Never mind the grunts and hisses--their flesh is sweet and delicious. Cut off the head, and eat only the body. Slit, clean and toast by the fire, or bake wrapped in seaweed.

OR BUILD YOUR OWN FISH TRAP

If you yearn for fish that is a little more familiar, you can catch them even though you're stuck on the beach--by the age-old method of trapping them with the tide.

Select a deep tide pool that is covered by water at high tide, but left open at low tide. Build a wall of rocks around three sides of the pool, its top about six inches below the high tide water level; leave the shore side open. Bait the pool heavily with fish guts, crushed clams and such.

Fish feeding as the tide rises will be lured by the bait and--with luck--will be trapped by the rocks when the tide goes out.

Try eating your fish with seaweed. Almost all Alaskan seaweeds are edible and provide important vitamins and minerals. One of the most common is sea lettuce, a bright green algae that grows in the low intertidal zone and looks like limp leaf lettuce. Talk to a local expert about edible and inedible plants in your area.

HERE I AM!

You hardly need to be told to keep a watch for rescuers. But you should be prepared at all times to signal them as well, and to keep signaling as long as the plane or boat is in sight.

Lay wood for a large signal fire out in the open where it can be easily seen. Keep it ready to go at a moment's notice. But don't light it until you are sure possible rescuers in a boat or plane have a good chance of seeing you. The time to signal is when they are near you or headed in your direction. Build a bright fire (dry wood) at night and a smoky fire (wet wood, spruce needles, alder leaves, or grass) during the daytime.

Put rocks, logs or stones in X or SOS shapes.

Have mirrors and orange clothing ready to shine and wave.

Most important, while you're waiting to be rescued, stay calm, but keep busy. Put yourself on a schedule. Move around. Gather wood and food. Don't let yourself get discouraged. And never give up.

8D Survival Puzzle

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1	2	3	4	▨	5	6	7	8
9				▨	10			
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28		▨	29		30	▨	31	
32		33		▨	34	35		
36				▨	37			

ACROSS

* 1. Stay close to your food and water supply when choosing a _____ site.

* 5. Standing dead trees make the best fire _____.

9. _____, twos and threes.

10. Alaska Newspaper Publishers Association (init.).

11. Overtime (abbr.).

*12. In a pinch, a coffee can can double as a cooking _____.

14. East Yahtse (river) (init.).

*15. That survival _____ isn't going to do you any good if you leave it at home.

*17. In cold rainy weather, wool clothes are better than your cotton blue _____.

19. Latin word for "and," as in _____ cetera.

21. Rhode Island (abbr.).

*22. A good survival food on the beach, and a gourmet dish at home.

*25. The best time to hunt for shellfish is on a _____ tide.

28. Alaska Airlines (init.).

*29. A tried and true way of cooking over a campfire is to toast food as you would with a hot _____.

31. Virginia (abbr.).

*32. For plenty of heat with less effort, keep your _____ small.

*34. In a survival situation, stay _____ the beach where you can be found.

35. In Alaska, these antlered animals can be hunted only in the islands near Kodiak.

*37. While you're waiting to be rescued, keep busy but stay _____.

DOWN

* 1. Almost all the food you gather on the beach can safely be eaten raw, but you'll probably prefer to _____ it.
2. A part of a word meaning "against," as in _____ toxin.
3. You and _____.
* 4. The toxin that is sometimes found in filter-feeding shellfish (init.).
* 5. Fresh drinking _____ is more important than food in a survival situation.
6. Preposition meaning "upon."
* 7. A good way to cook clams and mussels is to steam them _____.
* 8. A signal fire should be bright during nights and smoky during _____.
13. Nickname for the great football running back, _____.
*16. For a good hot drink, carry powdered coffee, _____ or Tang in your survival kit.
18. To feel sick.
*20. The position of the _____ is important when you're looking for food on the beach.
*22. Play it _____: Always let someone know where you are going and when you expect to be back.
*23. You'll need some of these to rig up your rainfly.
24. Short for "Behold!"
*26. Chitons are _____ shaped.
*27. To avoid hypothermia, you must stay _____.
30. Great Northern Company (init.).
33. Rock (abbr.).
35. Each (abbr.)

Starred (*) words are based on information in the preceding article.

Beachcombing Trip

BEACHCOMBING TRIP TURNS TO STRUGGLE FOR SURVIVAL
by Ward Sims

"BEACHCOMBING TRIP TURNS TO STRUGGLE FOR SURVIVAL" by Ward Sims is an Associated Press news story that appeared in the Fairbanks Daily News-Miner on Oct. 21, 1983. Reprinted by permission.

Stranded for four days on an uninhabited, wind-swept island in freezing temperatures, Clyde M. Dahle figures he beat the odds in surviving an ordeal that "only happens to the other guy."

The only memento is a slightly frostbitten toe that didn't require medical attention.

The 38-year-old Anchorage pilot was rescued on Wednesday after battling for survival on Hagemeister Island in Bristol Bay, some 400 miles southwest of Anchorage.

He took off from the tiny village of Togiak in his wheel-equipped, single-engine plane on Sunday to do some beachcombing on the island, and trouble barged in on him only moments after he touched down.

He had picked as his place to land the sloping, wave-pounded shore of a five-mile sand spit that stabs into Hagemeister Strait from the island.

While he was taxiing to the top of the spit where it was flat but covered with rocks and beach grass, winds to some 20 or 25 miles per hour picked up the wing of the Taylorcraft and flipped it into the water.

"Because of the steep drop-off of the beach, the airplane started to sink immediately," Dahle recalled on Thursday.

He said he grabbed his emergency locator transmitter and a bag of emergency gear, but the cabin of the plane had already filled with seawater and waves were pushing the plane farther off shore.

"In attempting to get out of the door of the airplane and out from underneath the wing to reach the surface of the water, I lost the bag of survival gear," Dahle said. "I came to the surface carrying only the emergency locator transmitter and the clothes I was wearing."

At the time, he was only about 50 feet from shore, but he said he was almost to the point of exhaustion before he was able to swim close enough to the sand spit to touch bottom.

"My first attempt was to get out of the wind," Dahle recalled.

He struggled down the spit to the island and crawled into a crevice between some rocks, lying there shivering and half-concious for several hours.

His clothes--wool thermal underwear, rubber-insulated pacs with wool socks, denim pants, cotton shirt, fiber-filled parka and one glove--were soaked.

"What I was wearing and the two pocket knives in my pocket were all that remained of my survival gear that I had stored in the airplane," Dahle said.

"All of my fire-starting materials, my big arctic sleeping bag, my extra rain gear, extra survival food, my large survival bag with all my flares, signals and mirrors that I always carry with me went down with the airplane."

He said he spent Sunday night in a small cave, shivering and shaking uncontrollably from hypothermia.

On Monday morning, he tried to get his emergency locator transmitter to work, but the circuitry had been damaged by seawater and it would not operate. He scratched out an "SOS" in a patch of black sand on the spit and dried his clothes as best he could by hanging them on bushes.

Then he went to work hauling white rocks to the distress sign he had scratched out.

Late Monday, an Air Force C-130 search plane flew over the island about two miles inland, but its crew apparently did not spot his SOS, or the waving white flag he had fashioned from a garbage bag found on the beach.

He also cut beach grass to insulate the cave.

By noon Tuesday, he had fashioned an SOS sign of white rocks with letters some 20 feet high. He also made a rock sign showing the number of his aircraft.

Late Tuesday he found an old tracked vehicle. He salvaged a foam rubber seat cushion which he cut up to insulate his body from the ground while sleeping and as a pillow. He also found a can of oil, and a large bottle with which to carry water from a small stream to his cavern.

Just before dark on Tuesday, a light plane flew high over the island and vanished.

That night, the temperature dipped to about 20 degrees, and Dahle said that while he slept better than on the previous two nights, he would awake often to find himself shivering and shaking from the cold.

On Wednesday morning, he found a handful of lingonberries, his only food, a can of charcoal lighter fluid, and a .22-caliber shell.

At about noon on Wednesday, a Coast Guard C-130 swept over the spit at an altitude of about 1,000 feet and someone aboard spotted his distress signal and his waving white flag.

The Coast Guard crew dropped a radio by parachute, and minutes later a float-equipped light plane from Dillingham landed on the water, taxied to shore and picked him up.

Dahle, who came to Alaska from Salt Lake City about 10 years ago and is now is employed by the State Division of Aviation, said it was his first accident in 14 years of flying light aircraft.

"I never even scratched the paint on a plane before this one," he said.

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